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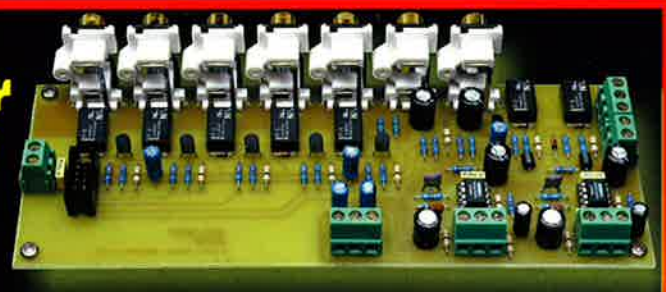

OCTOBER 2005

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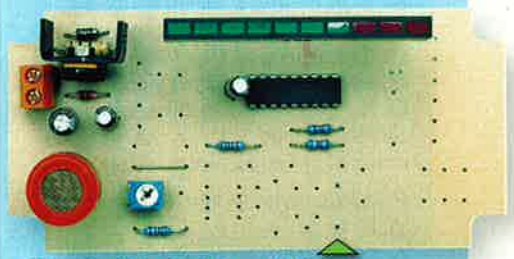

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SILICON CHIP
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SILICON CHIP is published 12 times a year by Silicon Chip Publications Pty Ltd. ACN 003 205 490. ABN 49 003 205 490. All material copyright ©. No part of this publication may be reproduced without the written consent of the publisher.

Printing: Hannanprint, Noble Park, Victoria.

Distribution: Network Distribution Company.

Subscription rates: $83.00 per year in Australia. For overseas rates, see the subscription page in this issue.

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ISSN 1030-2662

* Recommended and maximum price only.

Publisher's Letter

Valve amplifiers and self-delusion

Well, we certainly seem to have struck a chord with the publication of the Mudlark valve amplifier design in the preceding two issues, August and September. We have had some very enthusiastic letters from readers. At one level, I can understand the enthusiasm. With their glowing valves and the heat rising from them, valve amplifiers can seem almost animate, in much the same way as a steam locomotive at rest can seem almost "alive".

But on a pure performance level, I really cannot understand the attraction. Many people claim to love the sound of valve amplifiers, citing their "soft" overload and tendency to produce low-order harmonic distortion instead of the "highly undesirable high order" harmonic distortion of modern solid-state amplifiers. Now it is one thing for a musician to prefer a valve amplifier because of the particular sound it can be made to produce when playing a guitar. It is quite another for someone listening to CDs to prefer the sound of a valve amplifier over modern solid-state hifi designs which DON'T suffer at all from high-order harmonic distortion.

Unfortunately, there is lot of myth-making out there in the hifi marketplace and too many people just swallow it. For example, among some valve enthusiasts, single-ended amplifiers such as the Mudlark are much preferred over far superior class-AB push-pull valve designs. Partly, this is because single-ended valve designs have predominantly second harmonic distortion which is preferable to higher order harmonics. But what people do not realise is that these single-ended amplifiers have LOTS of second-harmonic distortion.

Furthermore, if you have high harmonic distortion in a circuit, you will ALWAYS have high intermodulation distortion. This is never mentioned when you hear people waxing lyrical about valve amplifiers. Intermodulation is the product of two different tones fed to a system – sum and difference frequencies are the result and these are never harmonically related to the input tones. On complex orchestral and choral music, high intermodulation sounds horrible.

Interestingly, before the advent of solid-state amplifiers, high quality push-pull valve amplifiers were the order of the day – single-ended designs were regarded with disdain.

But forgetting distortion – and many valve amplifier enthusiasts seem happy to do this – there is a huge amount of nonsense being circulated about valve amplifiers. For example, printed circuit boards are regarded (by some self-appointed gurus) as undesirable because they can lead to earth loops while supposedly, such problems do not exist in amplifiers with point-to-point wiring! In fact, some amplifiers are assembled with silver wiring because this supposedly minimises earth loop problems. What utter drivel!

By all means, build and listen to valve amplifiers if that is what you enjoy. They do sound quite different to the best solid-state amplifiers. They can even sound very pleasant. But to genuinely believe that typical valve amplifiers with low orders of feedback are more "hifi" and sound better than the best solid-state amplifiers is merely self delusion.

Leo Simpson

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MAILBAG

OK, we gave in . . .

I was reading some old SILICON CHIP magazines when I came across the July 1994 issue and had to laugh at your Publisher's Letter, "I (Leo Simpson) can state right now that SILICON CHIP will never publish a design for a valve hifi amplifier – never. They have no place in today's technology". What do they say about never? Never say never.

Kevin Taylor,
Auckland, NZ.

Comment: to be precise, the quote should be, "I can state right now that SILICON CHIP will never publish a design for a hifi valve amplifier unless it is for academic interest only. In fact, let's be even more absolute and just say NEVER."

In fact, the reasons for writing that editorial, that valve amplifiers perform poorly by comparison with really good solid-state models, are unchanged. But as you say Kevin, never say never! You can see why we were so reluctant to do it.

Valve sound with solid-state

With all the current discussions and projects featuring valves, can the "valve sound" be obtained by having a valve preamp and solid-state power amplifier? If the answer is yes, why not just go down this road and don't worry about 20-watt valve power amplifiers. After all, a 100W solid-state amplifier is easier to make; eg, your Ultra-LD Stereo Amplifier.

Ian Stewart,
via email.

Comment: the valve preamp followed by the Ultra-LD would give much better sound than a valve amplifier with transformers and not much negative feedback. However, valve sound enthusiasts don't seem to want that.

Publishing the Mudlark an inspired move

Your decision to publish the "Mudlark" valve amplifier project seems to be one of those inspired moves. As you point out, there are quite a number of readers who have more than a passing interest in the reproduction of recorded music and valve amplification, and there seems to be no good reason to withhold a project that could lead to much pleasure for these readers.

There are a number of aspects of the published design that deserve more than a passing look. Although some of these would appear to fly in the face of conventional knowledge regarding circuit design, many have in fact been conceptualised through years of empirical experimentation, rather than following the agreed scientific approach that would have resulted from the implementation of the "high-tech" proposition suggested in your editorial in the August issue.

I have a sneaking feeling that your idea of a high-voltage op amp followed by an ultra-linear valve output stage with bags of added negative feedback, would have resulted in a "worst of both worlds" design that might have measured quite reasonably but produced a poor sonic result when connected to real-world speakers in a domestic listening environment.

As you have pointed out on numerous occasions, if you want an exemplary set of measurements, SILICON CHIP's recent solid-state offerings are virtually unbeatable. That said, there are still many reasonably sane and intelligent folk out there who have no hesitation in selecting an amplifier that offers a lamentable set of figures but is capable of delivering an enthralling musical experience. In my experience, there are in fact very few solid-state designs that can boast likewise in a head-to-head "shoot-out" under controlled listening conditions.

Of course, a good amplifier can send what appear to be the right electrical impulses to the speakers and thence to the listener but in reality, there is often a huge difference in the enjoyment level of the resulting musical experiences. I feel that it is long overdue that technology was better applied just to give sheer listening enjoyment (as was the case in the early days of Radio & Hobbies and John Moyle's Playmaster valve circuits) rather than the "mine is bigger/better/more powerful/less distorted than yours, so shut up and listen" situation that is all too common these days.

The following are a few off-the-cuff avenues for those interested enough to actually build the Mudlark:

How many push-pull voltage amplifying stages has the program signal been subject to during the recording process? Every one of these has cancelled even harmonic information and proliferated odd harmonics. What has this done to the integrity of the performance? Would it be better to rebalance the signal by putting it through a circuit such as a single-ended valve power amplifier which will accentuate even harmonics and possibly restore a measure of "authenticity" before it reaches the ear?

Remembering that an electronically reproduced listening experience is a composite of all distortions encountered along the signal route (some additive, some subtractive) and that they are many and varied, what does it matter if the final amplifier introduces a few percent more, provided always that it is configured so as to mathematically reduce the corruption to the information arriving at the ear of the listener?

It should be noted that recording studios and their systems, pick-up cartridges, D/A converters, loudspeakers, etc inherently contribute up to a couple of percent distortion to the chain, so what is so appealing about a power amplifier that only adds .005% at the end? At best, it will do no more harm; but neither has it the potential to add a modifying factor that may undo some of the existing damage.

For those who would follow this line of reasoning and are prepared to think outside the conventional square,

it is worth reading some of the papers written by Eduardo de Lima (and others) on the subject of distortions in audio equipment. There are plenty of folk with a deep appreciation of music who feel strongly that the commonly referred to scientific principles do not provide all the answers to listening satisfaction.

SILICON CHIP is to be congratulated for its preparedness, no matter how reluctantly, to provide this avenue for the enquiring hobbyist; after all, isn't that what DIY magazines are supposed to be about?

Kerry Williams,
Applied Physics,
School of Applied Sciences,
RMIT University, Bundoora, Vic.

Comment: we had to check the date on your email to confirm that it wasn't April 1st. You're winding us up, right?

The idea of adding lots of even-order harmonic distortion during playback, to compensate for any distortion added during the recording process is problematical, to say the least. What people do not realise is that if a system has a high degree of supposedly "good" low order harmonic distortion, it will also have a high degree of intermodulation. Intermodulation is never good!

Interestingly, there is a precedent for adding distortion. In RCA's Dynagroove process, the recorded signal was pre-distorted and dynamically equalised to compensate for the poor performance of cheap phonograph players. At the time, most audiophiles judged the sonic results to be poor.

Cost of valve amplifiers not the issue

Your Publisher's Letter in the August issue is everything that a level-headed audiophile should agree with. Except one thing: "using high quality output transformers, such a design would cost well over $1000, which is the main reason we did not proceed."

For some of us (non-level headed), price is not the main consideration. It is about choice and I hope I will live long enough to see your $1000 plus design and have a chance to build it, as I have built a hundred or so projects from yours and other magazines. I cannot wait to start on the Mudlark – my order was placed the same day I got hold of your magazine.

I'd like to say one more thing. Reading your magazine is a pleasure and a joy. I fell in love with electronics when I turned 10 (46 years ago) and I am still going strong.

Bob Bozanic,
Traralgon, Vic.

Circuit wanted for Grundig "Satellit" receiver

I have a need for a circuit diagram for my Grundig Satellit 800 receiver. Grundig Australia say they have never heard of it and Grundig USA have not replied to my query.

I have searched the internet but have come up with the Users Manual, which does not have a schematic. Is anyone able to help? The radio is dead and will become an expensive boat anchor if I cannot repair it!

Ray Reaburn,
Mont Albert Nth, Vic.
ray35@optusnet.com.au

Digital cameras more convenient than 35mm

I must say I was very surprised at your negative reaction to digital cameras (Publisher's Letter, July 2005), especially in light of the fact that you use (have) one in your office. Only a couple of years ago, I would have agreed with you. But not now.

I agree you will pay more for digital than 35mm but five years ago, 35mm SLRs were about the same price as a good quality digital is now. It is unfair to lump all digital cameras as bad because of a single bad choice.

Recently, I went to Antarctica and took two digital cameras and one 35mm SLR. I could view my digital photos full size within minutes if I wanted and preview them seconds after taking them. I did a backup at the end of each day and at maximum quality and image size, never ran out of "film" (ie, memory card). I used a single 512Mb card and two 256Mb cards (one as an emergency). My laptop could directly read the cards, so I needed no extra cables. I could select the good shots and erase the bad ones.

My 35mm film had to wait until I returned. There aren't too many film labs in Antarctica! One of my rolls was

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completely blank – the film had not caught on the sprocket when winding on. With film, I had no choice about selecting which shots I wanted; I had to pay for them all, even the blank ones.

There has been a lot of comparison between the cost of film and the cost of digital. They all assume that you are going to print every photo you ever take. What about when you only want one photo? Is it reasonable to process an entire film? What about photos for email or screen-savers? Scanning film or a print is inconvenient and to do it at good quality is expensive.

The weight of an SLR and film would likely be similar to a digital camera, memory, charger and cables, so there would be no real saving when going overseas. The only issue is forgetting bits.

I have never needed to use the eye viewfinder – the LCD is sufficient for viewing in direct sunlight with only minor difficulty. Besides, I can always check my photos in the shade of my body after taking them. Most cameras have many assistance features on the display – a histogram, a manual focus assist area, horizon guide lines, etc.

Digital cameras still need work in the areas of reaction time (time between pressing the button and taking the photo) but pre-focusing can cut this dramatically.

Most of all, I want to know when my photos have turned out, rather than waiting several thousand kilometres (and dollars) to find out I had a finger smudge on my lens!

Despite having both 35mm and digital cameras, I have used my 35mm camera for about 30 photos in the time I have used my digital camera for about 4000.

Owen Scill,
Canberra, ACT.

Comparing digital cameras with 35mm equivalents

I read your recent editorial on low-cost digital cameras in the July 2005 issue of SILICON CHIP and have some comments.

You stated that, on a digicam like the Olympus C725, the depth of field is always poor because, in aperture priority mode, the lens aperture is normally wide open at f2.8. Although this might be so with a 35mm film camera, with a small digicam this is not actually the case. The depth of field of the C725 is quite large, in line with other small-sensor digicams, and it is much greater than in DLSRs or 35mm film cameras.

The reason behind this is that the C725 uses a tiny 1/2.7" CCD, whose dimensions are about 5.3mm x 4.0mm, which is much smaller than a 36 x 24mm frame of 35mm film. Compared to a 35mm film camera, the cropping factor for the lens on the C725 is 6.56. As the C725 has a lens whose focal length range is 5.9-59mm, when this cropping factor is applied, the lens has a field of view equivalent to a 38-380mm lens on a 35mm film camera.

One of the by-products of this is that when the C725's lens is set to f2.8, it will have depth of field approximately equivalent to a 35mm film camera set to f(2.8 x 6.56) = f18.4. That is a lot of depth of field! If you stop down to f7 on the C725, then that's equivalent to f45.9 on a 35mm film camera.

As it turns out, producing a shallow depth of field for creative purposes is one of the inherent problems with small-sensor digicams. Apart from other image quality and performance issues, it is one of the reasons why many professional photographers tend to prefer DSLRs, which either offer the same or slightly greater depth of field than a 35mm film camera.

Witold Waldman,
via email.

Earthing TV antenna masts

I'd like to thank Neil Hecker for his tip on reducing STB electrical interference (Possible Cure for STB Electrical Interference, Mailbag, August 2005), although it didn't produce quite the results I was anticipating!

Rather than earthing the coax, I decided to first try earthing the antenna mast instead, simply because this was easier to do. My antenna is mounted directly above a garden tap which is "first cab off the rank" after the 20 metres of buried copper pipe that comes from the water meter. Earths don't come much better than that!

Also, I just happened to have some off-cuts of "monster cable" that you could start a truck motor with and a handy pack of assorted hose clamps from a $2 shop! After some quick work with some sandpaper and application of the clamps and monster cable, that mast was about as grounded as you can get!

Did it fix the digital TV dropouts? Well not completely, although it certainly improved the situation. But what it *did* do was clean up all the assorted random interference I used to get on the analog channels!

Like many people in Sydney's outer-west, I get better reception of SBS and the ABC from Wollongong than Artarmon, so I have a band III VHF antenna pointed at Sydney and a high-gain UHF antenna pointed at Wollongong. This also gives me the regional versions of the commercial channels. I used to get intermittent patterning on most of the channels which I put down to meteorologically-induced variations in signal strength.

But since I've earthed the mast, I haven't seen a sign of the interference and the Wollongong commercial channels are now almost indistinguishable from the Sydney ones!

The intriguing thing is, I later discovered that there's no electrical connection between the antenna coax and the mast. Earthing the coax itself is a bit tricky as separate UHF and VHF cables are run to the antenna amplifier which is mounted in a fairly inaccessible spot under the roof tiles. What I'll probably do is strip back the outer jackets of the cables and clamp them to the mast but I want to make sure I can waterproof everything properly before I try that!

Anyway, it was an unexpected and amazing improvement for very little outlay!

Keith Walters,
via email.

Induction loop interference to video

I read with interest the letter from correspondent G. C. in the "Ask Silicon Chip" pages of the August 2005 issue, in regards to induction loop interference to a video projector.

As background, I have worked for several years for Audio Telex Communications who sell the Ampetronic range of hearing induction loop drivers and currently work for a sister company – Crestron Control Solutions. At the contemporary church of which I am a member, I have set up a reasonably complex video projection system that runs alongside a high-power hearing induction loop fed from a 24-channel audio mixer. We feed all computer and video sources into a Kramer scaler which converts numerous formats into RGBHV (SVGA) and then send that signal to the projector over 35m of high-quality cable.

Here are some extra insights that may be useful to G. C. I am assuming that he is sending data to the projector via RGBHV: I have found that it is important to use 5-core coaxial cable not 3-core, with data. It sounds as if he has induced noise on the horizontal or vertical sync signals (or both). He should ensure that the red, green and blue signals in particular do not have their earth connections tied together in the cable as this defeats the purpose of the transmission line, allowing ingress of nasties such as ghosting and smearing. Horizontal and vertical sync are effectively digital signals and so their sharing an earth is not so much of an issue.

Cables that I have used with great success are Canare V5-1.5C and Eurocable RGBYCD3. These can be terminated directly onto HD-15 connectors but it is a difficult job fitting everything into the backshell without shorting things out (heatshrink is your friend here). These cables are also quite expensive (about $10 per metre) but in my experience, worth every cent.

No cabling should be run parallel in close proximity (within two metres) to a hearing loop. Cables should cross the loop at 90° to minimise interference. This includes audio and mains cabling where possible.

If at all possible, the projector should be "flown" (suspended), as this removes it as much as possible from the plane of the loop where the field strength is at its greatest. It also helps remove the signal cable from harm's way.

Again, if at all possible, run the projector from the same mains circuit as the rest of the video system.

If feeding audio from the video system to the audio system, try using an isolation transformer to break the earth connection between the two sub-systems.

It may be possible that the loop is being over-driven and is producing much more field than is required by AS 1088.4. Valuable insights into the workings of hearing induction loop systems can be obtained from the Ampetronic web site (**www.ampetronic.com**).

I would strongly advise using a professional installer for a loop system as they will have access to design and analysis tools to correctly set up the system and deal with problems such as interfering fields from bad mains installations or field reduction caused by structural steel elements. It is also worthwhile to procure a loop listening device for testing and confidence issues.

From my reading of G. C.'s letter, he was sending RGBHV (ie, VGA or better) to his projector, not composite video. I believe that you can get 2.4GHz KVM switches that are good for up to 30 metres or so but would be nervous about that solution, particularly with the crowding of the 2.4GHz band that we've seen recently. Call me a Neanderthal but I prefer cable over wireless any day.

A number of manufacturers have systems that convert RGBHV into a format that can be transmitted down Cat.5e or Cat.6 cable (and be reconstituted cleanly at the other end). One is the Crestron QuickMedia system that can encode RBGHV (1600x1280), composite video, Y/C or component and send it (along with audio) down up to 100 metres of Cat.5e cable in a balanced format.

These products are more than just baluns; they involve serious amounts of signal processing and are not generally end-user installable. They are, however, finding homes in many university lecture theatres and classrooms, as the systems can be monitored remotely (via an Ethernet connection) using Crestron's Roomview software.

Phil Moore,
Crestron Control Solutions,
Silverwater, NSW.

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Beyond the world of Google™... there is

Everyone who has seen a demonstration of Google Earth is gobsmacked. Mind boggled. Blown away. Hey, we're not given to exaggeration – but we've got to agree. It is gobsmacking, mind boggling and blowing away! And the best part of all about Google Earth: it's free!

by Ross Tester

For computer users in the 21st century, it's hard to imagine life before Google. Only invented in 1998, Google has already entered the lexicon as a fully-fledged verb in its own right. You don't search on line any more. You Google!

Even if its name is an accident (Google was supposed to have been spelled Googol, a number with 1 and a hundred zeros, or 10^{100}), Google itself is no accident! But there is far, far more to Google than "just" the world's most popular search engine. Whether by acquisition or in-house development, Google has become an enormous powerhouse in the computing world. Here's just a small selection of Google's add-ons and other "products":

Google News – aggregated headlines and a search engine of many of the world's news sources.

Froogle – a product search engine and shopping directory. Assists consumers with locating products for sale online by presenting photos of relevant products.

Blogger – a tool to make Web log publishing very easy.

Google Toolbar – a toolbar featuring a Google search bar, as well as other Google tools. As of July 2005, Google Toolbar is available for two browsers, four operating systems and in ten languages.

Google Deskbar – search tool which runs from the Microsoft Windows taskbar, without a browser having to be open.

Google Desktop – where your search is internal; that is, within your own computer.

Google Groups – join (or even create) discussion groups, mailing lists and newsgroups.

Google News Alerts – Specify a topic and receive email updates when news breaks.

Google Web Alerts – Find out about new web pages on a topic of interest.

Google Glossary – Find definitions for words, phrases and acronyms.

Google Search by location – Restrict your search to a geographic area.

We could go on listing all day – but that would hardly leave room for the real feature of this article: Google Earth. If you'd like to go through all that Google itself has to offer, have a look at **http://en.wikipedia.org/wiki/Google_Groups.**

Google themselves say their company philosophy is built on a 70/20/10 rule: they spend 70% of company resources on core business – like search engines; 20% on closely related areas (like news), while the remaining 10% is where their engineers run amok producing oddball projects which don't fit anywhere but which are fun and/or interesting and/or groundbreaking.

But wait, there's more!

Some time back Google bought a little organisation called Keyhole Corporation. Reports suggested the main reason they bought it was that Keyhole was working on, and had just about completed, a highly innovative project. Google renamed that project Google Earth.

Without too much fanfare, Google Earth was announced to the planet at the end of June this year. And without wanting to get into hyperbole, I would describe Google Earth as "mind blowing". Everyone who has seen it (and I've shown anyone who would watch!) is astounded.

Google Earth is over-simply described as an image of the Earth, a globe if you will, which sits inside your PC monitor.

When Google Earth fully loads, (and it can take a good half minute on a typical broadband connection), a beautiful view of the Earth against a star background is revealed from some 38,500 miles (62,000km) out in space.

Not surprisingly (considering where it was developed, it shows North America... from sea to shining sea. But you can also "turn" the globe in any direction to reveal the whole planet. It looks pretty spectacular.

Ho-hum? You're not turned on by this? Anyone can display a nice picture?

Come on down to my house...

What if I told you that with the click of a mouse button, you can "fly" from right out in space to *any* point on that globe – right down to your own neighbourhood, almost right down to your own backyard (in some cases, *into* your own backyard!). You can zoom in, and in, and in – down to virtual ground level, in near-perfect clarity? Not quite so ho-hum any more?

Twist it, tilt it, move it . . .

Here's another of Google Earth's absolutely amazing features. With another click or two, you can tilt the view from straight down (plan) right through any angle down to horizontal (elevation). It's not yet perfect – but by the same token, it's not bad!

And if you don't like the view you're getting, you can turn it through any point of the compass. You can flick back and forward between plan and elevation. There's even a one-button "back to north" setting.

And at any time, you can move the whole view in any direction with four compass points on the toolbar. Hitting the red button at their centre will lock the centre of the screen so if you turn or tilt you stay viewing the area you are interested in.

You can reveal terrain, main roads, country and state borders . . .

As you move around or up and down, you will note that the screen is constantly updating. Google Earth is refereshing images "on the fly" from its obviously immense image database.

Note that as yet, you cannot access

The lonely planet from 30,000 miles.

Almost home! 15,000 miles out in space.

We've zoomed in to just 3,500 miles . . .

Here's the view from 1000 miles up.

At 100 miles, starting to see features.

hi-res images everywhere – this is an immense undertaking and will take some time – if ever – to complete (it's actually still in beta form). They are obviously concentrating on the major population areas and working down.

Deja Vu?

Some SILICON CHIP readers will be experiencing a sense of deja-vu. Something sounds familiar about all this?

Back in May 1999, we introduced you to the "Terraserver" website which also offered "pictures from space," with quite good resolution in some areas (especially if you paid for them).

That website has undergone quite a downgrade, where now it appears to offer USA images only – but even in its heyday it was nothing like Google Earth. For ease of use, features, clarity, value – Google Earth beats it every time. Terraserver never had anything like the features of Google Earth we've already covered, let alone the bits we haven't looked at yet.

What about World Wind?

You may or may not have heard of another, somewhat similar, site to Google Earth, set up by NASA. It's called World Wind and it's an 80MB download from **worldwind.arc.nasa.gov/download.html.** But in our brief look we found it doesn't offer anything like the features of Google Earth. It is free, though, so you might like to have a play.

The biggest difference between the two is that World Wind has all its images pre-downloaded; Google Earth updates its images literally "on the fly" – more on this aspect shortly.

And while mentioning alternatives, there is yet another Google offering, at the moment still in beta and certainly not complete, called Google Maps. Like Google Earth (even yet) it is very much more "finished" when it comes to the USA but even it its limited state it looks very promising. However, at the moment there are other "map" sites which offer far more, such as **whereis.com**, Yahoo and MSN.

Fly to Paris . . .

In some major world cities (particularly US and UK) most major roads are named. Click on "buildings" and all of the major buildings are outlined. When you tilt from plan to elevation at (near) ground level, the buildings become, well, buildings. (A tip: try this on London and New York City).

You can also highlight major roads, places of interest, show the terrain or turn it off (it's less confusing that way), show state and country borders, show restaurants and hotels (we'll look more closely at that feature later),

And before I forget, one of the most intriguing features of Google Earth: as you might expect (being from Google), it has search features. But they're extremely powerful: for example, the "Fly to" search. Simply type in the name of the place you want to go to (eg, Paris, France) and Google Earth "flies" you there. Up, up and away – across countries, oceans, even the poles, until you descend into your destination. And I mean *into* – right down to ground level! You really do have to experience this one!

Resolution

In high resolution, the images, which appear to be taken from a variety of satellites, are stunning in their clarity. Individual buildings, even houses, are clearly visible. So are cars and trucks on city streets. Many are so good that you can clearly pick out car windscreens – and some even better!

It would appear that the image resolution/quality has a lot to do with the source; also the "haziness" of the day in the particular city would affect it.

In low resolution, you cannot see individual buildings. The general "lie of the land" is relatively clear and you can pick out major landmarks such as big bridges and so on.

In hi-res, there is an optimum point to view detail – about 500 feet above ground level appears to be best. Any lower than this and images tend to become grainy and show artefacts. That's not to say you can't go lower – of course you can.

When I first saw Google Earth, about six weeks prior to writing this, it was not long after the London terrorist attacks. At the time, there was considerable (misguided!!) newspaper and TV reporting about the fact that on Google Earth you could see the ANSTO atomic reactor at Lucas Heights (south of Sydney) in great detail – and they showed it on the evening news, to prove it! "Authorities" were calling on the reactor site image to be pixellated on Google Earth.

In their typical "grab a story and beat it up" manner, the media failed to mention

Google Earth gets a lot of its imagery from DigitalGlobe's "QuickBird" eye-in-the-sky. This satellite orbits the planet at 450km and has a resolution as low as 61cm on the Earth's surface. Even this will be greatly improved early next year when the their "WorldView" satellite is launched. It will have a much higher orbit but even better resolution.

the fact that you could type "ANSTO" into **whitepages.com.au** and get the street address, then go to **whereis.com**, type in the street address . . . and up comes a map with the word "ANSTO" actually shown in place! Hmmmm.

I digress. At that time, some capital cities (Brisbane, Adelaide, Perth, Canberra especially) fared very well when it came to hi-res images. Much of Melbourne was, at least then, lo-res, a lot more obscured by cloud. Even some major centres like the Gold Coast were in hi-res (but not the Sunshine Coast).

Unfortunately for me, Sydney was also about 50% lo-res. For those who know Sydney, everywhere south of the city was brilliant but the city itself and anywhere north were not.

Not being able to view my own area at the time, I decided to find my mum's place on the Gold Coast. Zooming in and following the Pacific Motorway north was dead easy – then I got to the familiar exit ramps at Mudgeeraba. I followed the road along until I turned off towards Mum's retirement village. Next I zoomed right in and was easily able to pick out her villa.

It was so clear I almost expected to see her standing in the front garden waving to the satellite . . .

The above paragraph gives us land-bound novices a good clue on how Google Earth is best navigated. "Flying" over large areas and finding objects is not quite as simple as it sounds – just ask any pilot who's had to learn to navigate. The view is a lot different from "up there"!

The trick is to find something that you do know and follow roads, railways, rivers etc, to where you want to go.

The exact latitude and longitude of where the cursor is located is shown at the bottom of the screen – I've made a note of various things I might want to go back to.

And when I say exact, it is that: it's calibrated to degrees, minutes, seconds, tenths and hundredths of seconds. (At the equator, a degree is about 69.16 miles or 111.11km, so a minute is about 1.85km and a second about 30.8m. That makes a hundredth of a second just 30cm – about a foot in the old money!)

Oooh –it's changed!

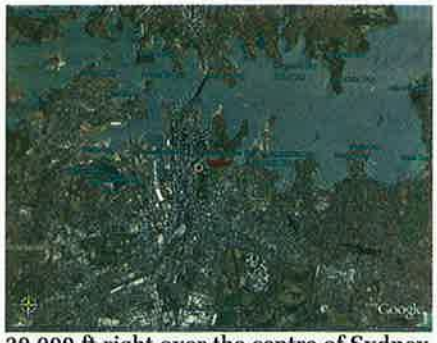
Very recently, I was idly "playing" with Google Earth (it still fascinates me!), once again looking at Sydney. Hey, what's this? All of Sydney City now in hi-res – you could even see the shadows of the Harbour Bridge on the water! Oh, bliss!

So I quickly "flew" up the northern beaches and, sure enough, hi-res images greeted me for at least most of the way. As (good!) luck would have it, the hi-res images ended about 500 metres beyond my place! Yay!

And I must admit our publisher was pretty chuffed when I showed him his mansion in glorious hi-res . . .

This demonstrates the evolving nature of Google Earth. As new images become available (and obviously the time to work on them) they will be implemented into Google Earth. Our deductions, from looking at homes and buildings under construction in our area, is that the image was captured about February or March of this year. The image of southern Brisbane, while hi-res, is about two years old. I can see a town house I now own still "under construction" (in fact it is just a patch of dirt!) – and I've been paying for it for

30 miles (160,000 ft) – becoming clearer.



30,000 ft right over the centre of Sydney.

10,000 ft and the city streets are visible.

1,000 feet above the Opera House

Finally, 500 feet – yep, those are people!

A section of lower Manhattan, New York City, from 1 mile up. The brown area top centre-left of the pic is where the World Trade Centre once stood.

They are a bit indistinct at this size- but each one of the labels shows either a restaurant or hotel. Advertisers pay to have their business names appear.

Here's what happens when you highlight the "buildings" button: all of the major buildings in New York City appear, complete with shadows!

more than a year since completion!

Who supplies the images?

All of the images which come up on Google Earth are copyrighted to various organisations. Brisbane closeup, for example, is copyrighted to DigitalGlobe, while as you zoom out, the copyright changes to EarthSat.

DigitalGlobe appear to own their own satellite – QuickBird, launched in 2001, which orbits at an altitude of 450km, in a 98°, sun-synchronous orbit.

They claim it is the only spacecraft able to offer sub-metre resolution imagery, industry-leading geo-locational accuracy, 128GBits of data storage and an imaging footprint 2 to 10 times larger than any other commercial high-resolution satellite.

Its resolution is 61cm panchromatic and 2.44m multispectral. With a swath (image capturing path width) 16.5km wide, every year QuickBird collects over 75 million square kilometres of imagery data.

But even that will be overshadowed by DigitalGlobe's next satellite. Scheduled to launch no later than 2006, WorldView will be the world's only commercial satellite to snap pictures of the Earth at 50cm resolution.

The satellite's higher orbit, at nearly 800km, will allow it to revisit collection areas more frequently – about once a day. The WorldView system will include more efficient image processing systems and multi-satellite collection planning, shorter tasking timelines and an expanded network of remote ground terminals. DigitalGlobe's imaging constellation combining WorldView and QuickBird will be capable of collecting more than 4.5 times the imagery of any current commercial imaging system.

By late 2006, WorldView alone will be capable of collecting nearly 500,000 square kilometers (200,000 square miles) per day of half-metre imagery.

EarthSat, on the other hand, uses a variety of satellites including the various Landsats, SPOT, IRS, IKONOS, Terra, JERS, AVHRR, OrbView and DigitalGlobe's QuickBird. Depending on the swath, and therefore the resolution, some of these satellites have a revisit time as short as 1 day (Spot-4, 2200km swath) while JERS-1 has a much narrower 75km swath and takes 44 days to revisit.

Some areas, especially the USA, appear to switch to aerial, as distinct from satellite, imaging at low heights (for example, New York City close-up images are from The Sanborn Map Company, Inc).

With these images, you can actually see people on the city streets, even street light poles! You can't quite see the leaves on the trees but you can certainly pick out branches . . .

What does it cost?

We have already mentioned that the basic version of Google Earth is, at least currently, a free download. But using it does have a cost!

The price you pay is in the bandwidth you are paying for as you use it. And that can cost you plenty, depending on the particular broadband plan you are on.

When talking to some friends about Google Earth, one made a comment about it being a "bandwidth muncher" and very costly to use.

So I did some investigating on this line and, as they say in the classics, there is good news and bad news.

We'll start with the bad news. We mentioned earlier that the pages update "on the fly" using streaming technology.

A general rule of thumb for streaming

And now look what happens when you "tilt" the image. We're at about 45° here – you can go down almost to ground level if you wish!

To prove the point, here's the elevation view of Manhattan from 90 feet. This actually has the "terrain" feature switched on but NYC is fairly flat . . .

Just 150 feet above a bus stop in The Battery area (lower left of other pics). The clarity of view is sensational – one day it may all be this good!

video usage is about 2MB per minute.

Using a downloaded shareware utility called Networx (**www.softperfect.com**) we monitored Google Earth usage and confirmed this to be about right: usually about 25-35KB per second, which does equate to roughly 2MB per minte.

So if you were *constantly* using Google Earth for an hour, you could easily eat up 120MB of your allowed bandwidth – not very good if you're on one of the cheapie 150MB or 200MB per month plans!

But here's where the good news comes in. Unless you are constantly changing positions or views, the streaming doesn't continually occur. In fact, for significant periods of time, our usage meter was saying perhaps 1-5KB per second, an average of perhaps 100KB per minute: much more user (and wallet) friendly.

The moral of the story is that like any streaming source, you should keep your eye on your usage. It's easy to exceed your plan limits and some ISPs charge like wounded bulls once you do so.

More Google Earth power?

Google Earth is also available in two higher-featured versions, neither of which is free (but one is pretty cheap).

Google Earth Plus is an optional upgrade adding GPS device support, the ability to import spreadsheets, drawing tools and better printing. It costs $US20.00.

Further upmarket is a version for professional and commercial uses, **Google Earth Pro**. It is described as the ultimate research, presentation and collaboration tool for location information. Google Earth Pro makes location research and presentation easy.

Google Earth Pro costs $US400 but there is a 7-day free trial offer to find out if it is what you need or want. Google Earth Pro itself has a number of add-on modules, each priced at $US200 – Movie Making Module; Premium Printing Module; GIS Data Importing Module; GDT Traffic Counts Data; and NRB Shopping Centre Data.

You'll find more information about these modules on **http://earth.google.com/earth_pro.html** along with a lot more information about Google Earth itself.

What you need

Google Earth itself is a free (and relatively small – around 10MB) download. You can find it on http://earth.google.com.
However, you're going to need some reasonable firepower to run it. If your PC is, say, over four years old (even two years old in the case of many notebooks), forget it!

The minimum hardware configuration is:

* CPU speed: Intel® Pentium® PIII 500 MHz
* System memory (RAM): 128MB
* 200MB hard-disk space
* 3D graphics card: 3D-capable video card with 16MB VRAM
* 1024x768, 32-bit true color screen
* Operating system: Windows 2000, Windows XP

Recommended configuration:

* CPU speed: Intel® Pentium® P4 2.4GHz+ or AMD 2400xp+
* System memory (RAM): 512MB
* 2GB hard-disk space
* 3D graphics card: 3D-capable video card with 32MB VRAM or greater
* 1280x1024, 32-bit true color screen
* Operating system: Windows XP

Internet Connection

As we said earlier in the article, Google Earth downloads its image data as you go to that location (it's called "streaming"). A broadband connection is essential – preferably a fast one. Minimum speed for practical use would be 128kbps but you will get much more satisfactory results with a 768kbps – or even faster – broadband (ADSL/Cable/Wireless) connection.

How does Google Earth make money?

I cannot believe the number of people who have said "if it's a free download, how does Google make money?"

Google Earth is more or less an extension of Google's search engine technology. Just as restaurants currently pay to advertise in the media, they will pay (and already are paying) to have their name – and location – come up on Google Earth when you are looking for somewhere to eat in that area (again, check out New York City).

That's just one example. Google rates are low by comparison to other forms of media – as a global organisation they don't have to charge much because the market is so huge – and growing.

And finally, you may have heard recently reports that Google founders Larry Page and Sergey Brin recently knocked back an offer of $3 billion from News Ltd.

Is there money in Googling? We think there might be a few cents here and there. . . SC

Hi, mum! One of those villas is her place on the Gold Coast. The images, from 450km away, are so clear I almost expected to see my mother standing in the front garden waving to the satellite . . .

It's not Power over Ethernet . . .

NetComm NP210: Ethernet Over Power

There's a rather clever ad on TV at the moment which has the tag "isn't it nice when things just work". I'm sure you've seen it. While this review has nothing to do with a Honda car, it has everything to do with things "just working".

It's so nice to find a product which not only delivers what it promises – it does it without any hassle, any setup difficulties. It just works!

Over the years, we've looked at many types of computer networks, some in considerable depth.

This month, it's another type of network. But it is quite different in that, while it is wired, the wiring is already in place in your home or office. This network uses the power lines running through the building (and even beyond) as the network. It's called Ethernet Over Power (EOP)

Ethernet over power does exactly what its name suggests – there is no wireless, no Cat5, no coax – the 240VAC power wiring, as well as supplying power, supplies the network connection. In other words, the data stream is superimposed onto the mains at significantly higher frequency that the 50Hz mains – in fact, it's in the several MHz range. Using power lines for networking has been in the pipeline (no pun intended!) for some years, with various systems set up here and overseas to test it out.

To our knowledge, this is the first system to actually reach it to market, at least here in Australia. There are other power line systems currently becoming available which offer broadband over power lines – we understand trials have been conducted in Australia but so far, we haven't heard of anything further.

First, let's explain the NetComm HomePlug system. As our photo shows, it looks like a pair of plugpacks and a couple of Ethernet connection cables. And, apart from a CD loaded with software and manuals-on-disk, that's exactly what you appear to get when you open the package.

But those "plugpacks" are not quite what they seem. Yes, there is a power supply built into them. But they also contain the "smarts" which turn them into network adaptors.

Each terminal on the network requires one of these plugpacks. The basic package contains two plugpacks; you simply buy as many as you need, up to the maximum of 15 terminals.

Also, each of the terminals needs to be on the same wiring circuit, or phase. That's usually not so much of a problem in a home setup because most homes are fed by a single phase. In an office, it might not be quite so simple because all three phases are used in many cases to distribute loads – and this system cannot cross from one phase to another.

NetComm claim a range of up to 200 metres, which is far more than most LANs would need. We weren't able to confirm that range because we couldn't easily get two houses 200m apart on the same phase! However, we did confirm a range of more than 70m plus, with the aid of a long extension lead and a pair

siliconchip.com.au

of notebook computers.

But we are getting slightly ahead of ourselves. At the outset, we said that the systems simply works. And it does.

There is a Quickstart card in the box which basically tells you what to do: load the driver software, plug the adaptors into power and the Ethernet cables into the appropriate (RJ45) sockets on your PC and on the adaptors – and that's it.

It just works!

So I followed the Quickstart card – and away it went! No problems whatsoever. The two computers found each other without any problems at all and I was able to transfer data back and forward, examine one's hard drives from the other, etc etc – exactly as I could have done had they been connected via my wireless network (which of course I disabled first) or via a "normal" Ethernet (wired) network.

One curious thing: on one PC the signal strength meter told me I had excellent signal (100%, in fact); on the other PC, it told me the signal strength was low. No, I don't have a clue why! Working from one to the other and vice versa appeared to be pretty much identical, with plenty of speed, etc.

Speaking of speed, how fast? The specifications say that they are up to 14Mbps – faster than 10base-T networks but not as fast as 100base-T; faster than 802.11b wireless but not as fast as 802.11g wireless. I was able to confirm this as pretty accurate.

Like any network, speed depends to a large degree on distance; as I mentioned before, I wasn't able to stretch mine out to the 200m maximum but room-to-room, it worked like a charm.

As far as speed is concerned, 10base-T and 802.11b networks are more than adequate for surfing the 'net – therefore Netcomm's HomePlug system was too. For the vast majority of users, speed would not be an issue.

But if you are after maximum throughput (or more likely have a lot of high-level users trying to use the network at the same time), the speed limitation might start to become relevant.

The question will obviously arise: what happens if your next-door-neighbour decides to put in the same system? At the risk of sounding smart, nothing – if not only because the way power wiring is distributed in Australia, adjacent homes are almost always on different phases.

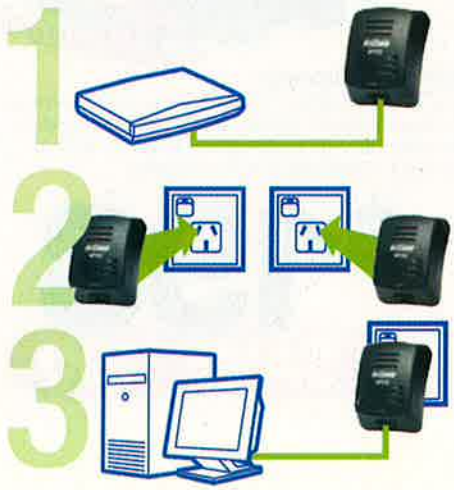
But that's not the only reason – the NetComm HomePlug has 56-bit DES encryption with key management; it also operates on a large number of channels over its 4.3–20.9MHz operating band.

Netcomm's marketing is directed at people who (a) cannot or do not want to install a wired network – such as flat dwellers, renters, etc; and/or (b) want Internet access from various rooms as simply as possible.

The system is highly suited to both these groups – as it is to small businesses, conferences, consultants – in fact, anyone who needs to set up a network quickly and easily.

Recommended price of the NetComm NP210 HomePlug system is around $199, although we have seen it advertised up to $45 cheaper!

For more information, including online suppliers, visit www.netcomm.com.au/Networking/eop.php SC



It really is as simple as 1-2-3: (1) Connect a HomePlug to your ADSL or cable modem using the supplied cable; (2) Plug that HomePlug into a convenient power socket and the other HomePlug into a socket close by your PC (or game console); and (3) Connect the other PC to the HomePlug. OK, there is are 4 – All you need to do now is run the driver software contained on the CD supplied with the kit – and that's pretty much it! (*Graphic courtesy NetComm*)

NP210 TECHNICAL SPECIFICATIONS

PROTOCOL/STANDARDS
- HomePlug 1.0 specification, IEEE 802.3 10 Base-T Ethernet (10Mbps) compliant
- 10Mbps AutoMDI/MDIx Support
- 14 Mbps HomePlug 1.0 compatible
- CSMA/CA MAC Control

MODULATION SUPPORT
- OFDM, DQPSK, DBPSK, ROBO Carrier Modulation Support

FREQUENCY BAND
- 4.3MHz ~ 20.9MHz

QUALITY OF SERVICE
- Forward Error Correction (FEC) support
- Channel Adaptation ensures that signal integrity is maintained even under harsh noise environment
- CSMA/CA with prioritisation and Automatic Repeat Request (ARQ) for reliable delivery of Ethernet packets via Packet Encapsulation
- Four Level prioritised random access method
- Segment bursting and contention-free access ensures high throughput while maintaining low latency response and jitter performance

SECURITY SUPPORT
- 56-bit DES Encryption with key management for secure powerline communications (Use Windows platform to enable encryption)

PLATFORM SUPPORT
- Windows 98SE, Me, 2000 or XP

POWER SUPPLY
- Integrated 240V AC supply via power socket

EXTERNAL CONNECTORS
- 1x electrical power socket
- 1x RJ45 for 10 Base-T ethernet (Auto MDI/MDIx)

APPROVALS
- C-Tick
- Energy Authority Approval - Q050207

SYSTEM REQUIREMENTS:
- Windows operating systems with Ethernet connection, Pentium II 300MHz MMX-Compatible PC or greater, minimum 64MB hard disk space and memory, CD-ROM drive
- Maximum of 15 devices connected to power line network
- All HomePlugs must be on the same power circuit

PACKAGE CONTENTS
- 2 x NP210 HomePlug Adaptors
- 2 x RJ45 10/100 ethernet cables
- 1 x configuration/manual CD
- 1 x Quick Start Guide

BENCHMARK Oct 2005

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The perfect solution if you need more than 1 set of AV inputs on your TV. No need to plug and unplug devices to use them – on Auto mode will automatically select the input that has a signal present. Allows up to 4 AV devices to be connected to a TV at the one time. Includes an AV cable and AC power supply. L 5968

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16

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Products also available through www.dse.com.au

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New heavy duty hardened METAL casing in a bright safety orange colour. Surge and overload protected power sockets, RFI and EMI mains filtration and illuminated master on/off switch. Includes 1 spaced outlet to accommodate power packs or transformers and a handy wall mounting option with screw slots in casing. Ideal for use in areas including workshops, laboratories, farms or factories.
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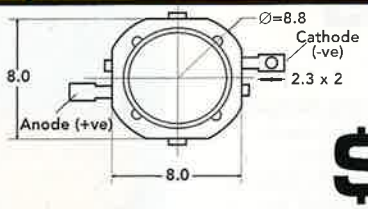
PVC Insulation Tape
The everyday general purpose black PVC tape for all those small jobs around the house or garden. 18mm x 18m. N 2362

88¢

VALUE



'Cyclops' Hi Power 1W LED
High luminous flux, long operating life of up to 100,000hrs (absolute maximum ratings not to be exceeded). Requires heatsinking and a constant current source. Includes data. Three colours available.

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Aggressive contact cleaner for electronics, PC boards, televisions, computers and phones. Non-flammable. Not suitable for many plastics. 200g can.
N 1197

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The electronics

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DVR (Digital Video Recording) is the answer

- Cost effective, simultaneous monitoring and recording of up to 4 security cameras with motion detection
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Swann

Complete Digital Guardian DVR Surveillance System
Quick and easy to install, 4-channel digital video recorder with audio. Capable of picture-in-picture and picture-on-picture function and up to 4x zoom. LAN and WAN ready, allowing connection to your existing network or monitoring via the web from a remote PC (software included). L 5903P

Includes:
- Swann Digital Guardian DVR
- 2 x C-500 Professional CCD Colour Cameras, High Resolution for indoor monitoring.
- 2 x Bulldog Cam Professional CCD Colour Cameras, robust weatherproof metal housing, suits indoor and outdoor, night and day security applications.
- 120GB Internal Hard Drive Kit.

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Kidde
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Easy to install, no wiring needed, 85dB alarm, 3 year limited warranty, AS Approved. L 5676
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Imitation car alarm 5mm flashing LED. L 5322
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A reversing alarm that produces a loud, shrill, pulsing sound – great for motor vehicles. L 7060
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Encased for easy mounting with double-sided tape and screws provided. Dimensions 64(L)x 15(W)x 18(H)mm. N.O and N.C contacts. L 5211
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Easy to build project, lets you take your own electrocardiograph (ECG) and displays it on a PC (via USB). You can read, display, save to disk and print the electrical waveform generated by your heart. Includes all components, hardware, PCB, a specially manufactured case that has been fully drilled, powder coated and screen printed as well as a set of ECG pads to get you started.
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A low noise stereo pre-amplifier that is ideal for use with magnetic cartridges, cassette decks or microphone inputs. Output 0.5W into 8ohms, a 9V supply with components and a PCB, optional case. K 5604

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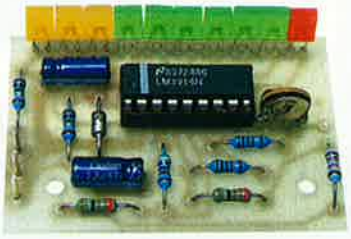

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Simple and functional kit to monitor your car battery.
K 4611

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NEVER REPLACE A TORCH BULB AGAIN!

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Build a solid-state torch with a white LED. Receive high brightness with cool white light, low battery drain and you will never need to replace a torch bulb again. Supplied with all components, including white LED, PCB and mini torch. K 3018

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Operates on 3 x AA size batteries (not incl.) up to 40 minutes with Alkaline batteries, combined heater element and tip (made in Japan) for greater reliability and faster heat-up. **T 2502**

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At last an economical oscilloscope that everyone can afford! An easily transportable portable CRO with bandwidth of up to 10MHz and sensitivity of 5mV/DIV to 5V/DIV. Easy to operate and highly reliable, it is an ideal scientific and engineering instrument for a wide range of uses including hobby and education. Supplied with a 1:1/ 10:1 probe. **Q 1803**

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HOT PRICE

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Analogue Sound Level Meter

Comes with a large analogue meter movement for easier viewing with 7 sound level metering ranges covering 50-126dB SPL. Selectable A and C weighting to account for hearing response at different levels and an output socket for connection to other equipment, such as home theatre or test equipment. It uses an omni directional electret condenser microphone for sound collection and the analogue meter reads with slow or fast response times for checking peak/average levels. Tripod mountable (not included), comes with a convenient carry case. **Q 1461**

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HOT PRICE

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ideas for all!

CLEARANCE

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Workman's Board
10m extension lead and 4-way power board, circuit breaker protected, lifetime warranty.
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6 surge protected 240V mains power outlets and 1 surge protected phone module. M 7655 LIMITED STOCK

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Built-in microphone, easy mounting, connects to your TV/VCR/DVR/Quad processor and more. Incl.10m cable. L 5915

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CLEARANCE

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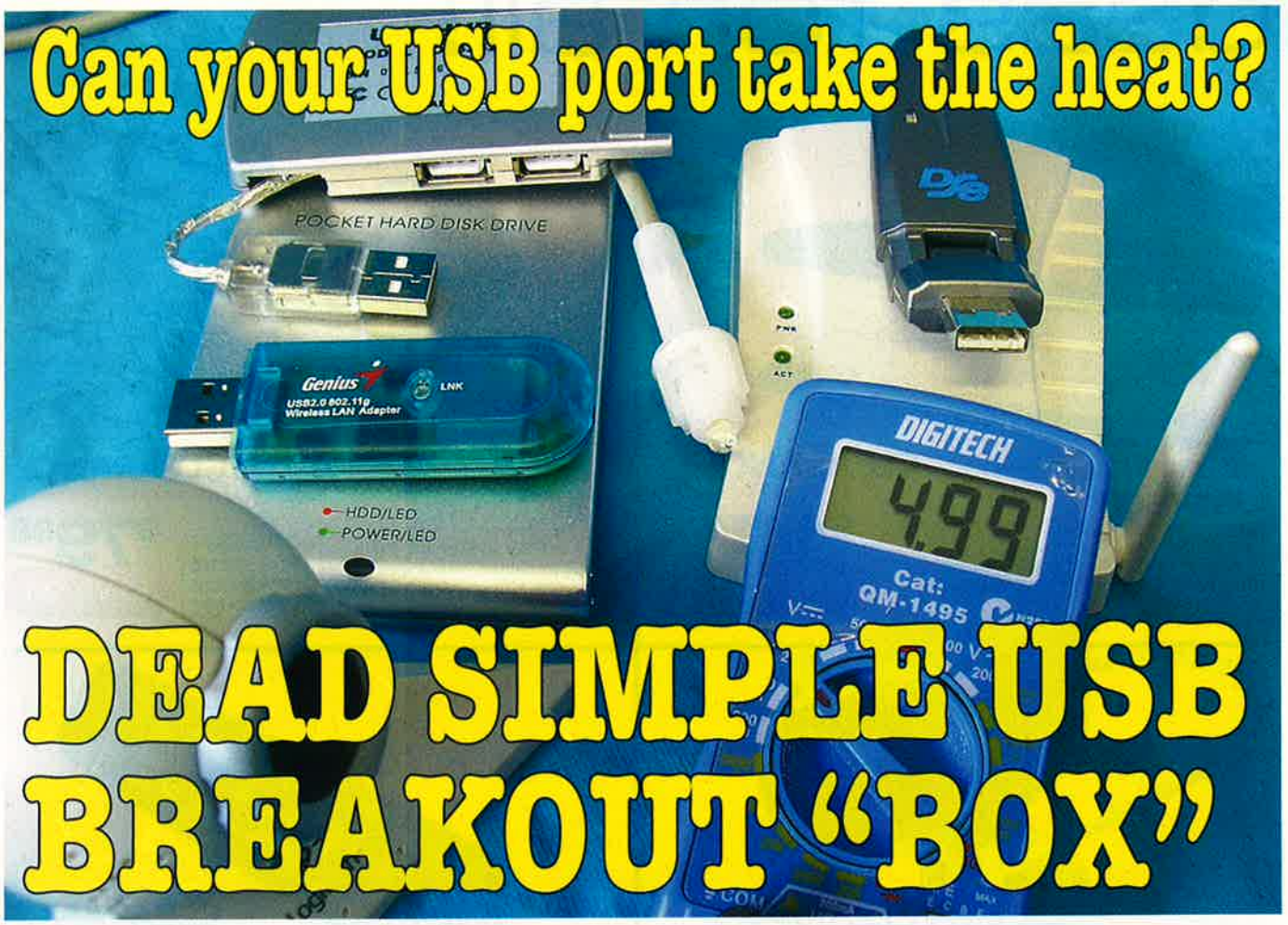
9563



The USB port has made PC expansion so delightfully simple it's a wonder no-one thought of it before . . . but it has its limitations. Most PC users are completely unaware of this and wonder why the computer starts giving error messages or the USB devices themselves either stop working or misbehave. Here's a really simple way to find out what those devices are doing. . .

Computer interfacing via Universal Serial Bus (USB) ports, in either 12Mbps (Version 1.1) or more recent 480Mbps (Version 2.0) offerings, has deservedly become such an indispensable connection method that it's hard to realise USB has only been in use for just five years.

Apart from seamless "smart" data connections for digital cameras, flash RAM dongles, WiFi adapters, modems and mice, etc, the availability of a regulated 5V DC supply at relatively generous currents has also lead to such diverse "dumb" devices as mobile phone chargers, coffee cup warmers, cooling fans and inspection lights.

Dumb, of course, refers to the hi-tech USB data lines (middle pins 2 and 3) being ignored and just the low voltage DC being exploited at (outer) pins 1 and 4.

The PC's USB port can supply up to 500mA @5V; however, downstream ports on USB devices are generally limited to 100mA maximum.

Although it may be considered frivolous to use a $1000 PC to just power a light or charge batteries, the computer may be on anyway and equipment powered by the 5V USB supply is often conveniently associated with one's needs at the time.

by Stan Swan*

Cold coffee, when trying to tame a late night spreadsheet macro, can easily ruin one's concentration!

The USB specification allows up to 5m of connecting cable, since signal timing issues may give data corruption with longer lengths. However, basic DC electrical issues also arise, with heavier currents giving unacceptable supply line voltage drops that infringe typical 5V ±0.25V load electronics needs.

As an example, Ohm's law tells us if 250mA is flowing through a wire of resistance 0.5Ω, then a tolerable drop of I x R = 0.25 x 0.5 = 0.125 Volts will occur.

This wire with the 500mA maxi-

siliconchip.com.au

mum load, however, would drop 0.25V and deliver only a borderline 4.75V to the load, which may therefore work unreliably.

An additional issue relates to the power needs of the numerous items now in use. Even with short cable lengths, multiple USB devices (and up to 127 are possible!) can eventually demand more current than is permitted, with resulting port shutdown.

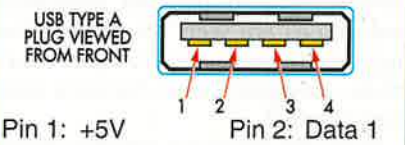
Unpowered hubs are particularly prone to this, which explains the need for powered USB hubs that will cater for multiple energy-hungry add-ons.

Alternatively, a simple USB power injector could be used with an unpowered hub to achieve the same result.

SILICON CHIP published such a project in the October 2004 issue, capable of supplying 5V DC @1A to a USB device. Need more power than this for other devices? Add more power injectors!

Even though itself now threatened by other advances in technology, Bluetooth is finally making a solid showing. Particular interest in verifying the output power of USB Bluetooth adaptors has therefore arisen.

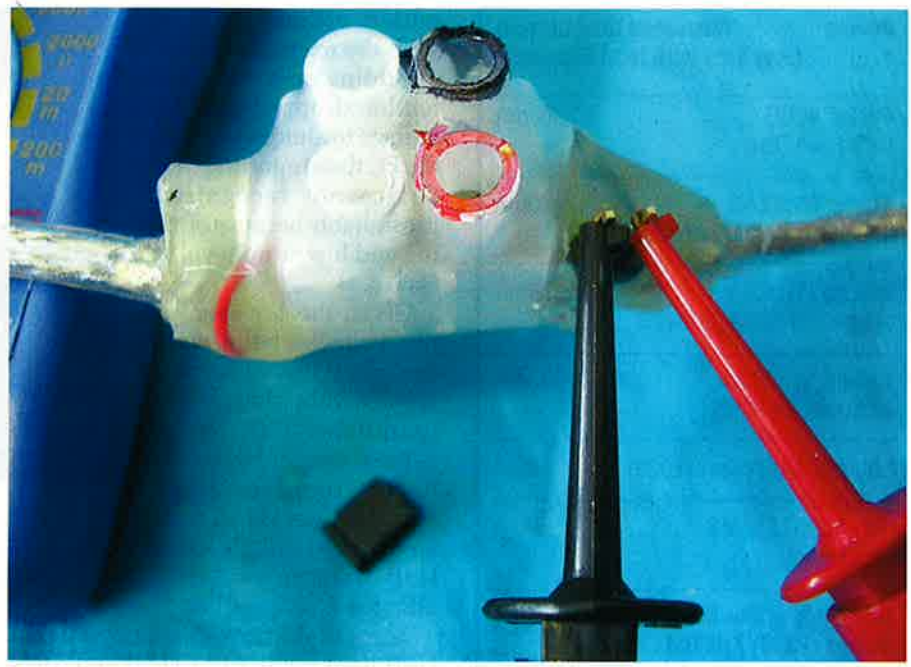
The three Bluetooth classes have *decreasing* wireless power and range, and innocent purchase of a low power Class 2 adaptor may frustrate when



The connections to a USB type-A plug (the one that goes into your PC).

range has to be maximised. The most powerful Class 1 is typically good to 100m, with Class 2 some 10m and Class 3 just a metre "across a motherboard".

Although not specified in classes,



Here's Stan's prototype USB breakout "box", potted in some hot-melt glue. The idea is to poke your multimeter probes into the terminal block (avoiding shorts) for voltage measurements; for current measurements, you remove the header pin shorting block and connect your mulitmeter in series.

(instead usually having power quoted in dBm [15dBi = $10^{1.5}$ ~ 40mW]), increasingly popular USB WiFi adaptors also differ significantly in their transmitter output power.

This is especially important when some distance from an Access Point since you may be able to "hear" its strong signals – but it may not sense your weak out-going ones.

Given these issues, it's surprising USB supply breakout adaptors haven't become readily available, since simple current and voltage measurement of assorted loads can be extremely revealing, especially if device specs are being stretched.

Make your own!

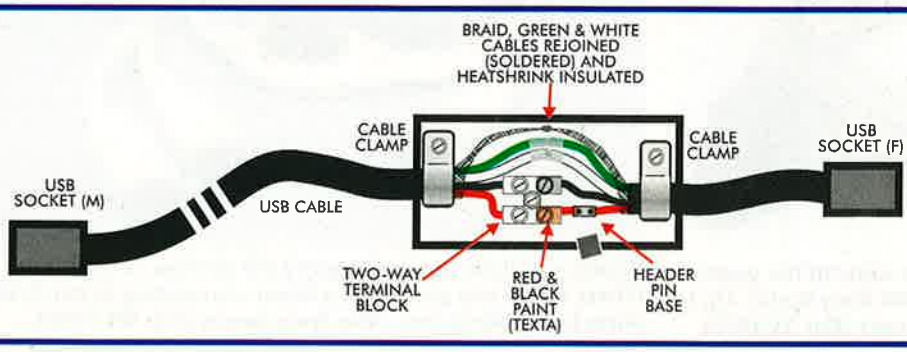
With the cheapness of short USB M-F cables and DMMs, a simple supply breakout adaptor can quickly be organised by just cutting the cable. Position of the cut is unimportant – just ensure the data wires (usually green and white) and the braid are neatly resoldered and heatshrink covered, with no mischievous whiskers from the braided shield!

A small terminal block makes for convenient voltage test points across the red and black supply wires – even though a DMM won't be worried by reverse polarity, we painted our terminal block red and black with a Texta pen to identify "+" and "–".

For current measurement (which of course must be in series), we included a 2-pin header pin base in the +ve (red) wire.

To measure current, the shorting block is removed revealing a handy pair of terminals for our multimeter clip leads.

Overleaf are some sample measured currents, using a short 600mm cable to typical loads, supplied from a mains-powered Toshiba laptop –



This diagram shows how it can be done – slightly more permanently than the glue version above. We used a small block of timber to mount it on – but just about any non-conductive base would be fine. The header pin base was glued to the timber using hot melt; small woodscrews hold both cable clamps and the 2-way terminal block in place.

Device	Measured load current (may vary with load demands)
Pocket 40GB USB Hard Disk	300mA
Atmel "b" WLAN adaptor DSE XH7947 (2002)	270mA
DSE "b" WLAN adaptor XH6822 (2004)	90mA
Genius "g" WLAN adaptor GW-7200U	63mA
Logitech Quick Cam(2000)	60mA
"My Flash" 256MB Flash RAM	50mA
DSE Class 1 BlueTooth dongle (2003) XH4104	48.5mA
"Itsy-Bitsy" USB LED lamp (ref SILICON CHIP, March 2002)	30mA
Genius Mini Traveller USB mouse	10mA
Prolific USB-serial D9 adaptor (Picaxe use)	8mA
Olympus C-1 digital camera (64MB Smart Media). Perhaps camera batteries supplying too?	< 1mA

This laptop PC's unloaded USB supply was measured at 5.04V, which dropped when loaded by the power-hungry Atmel WLAN adapter (drawing 270mA) to 4.88V with a 600mm cable and just 4.75V when at the end of a 5m USB 2.0 extender.

This 5m cable was measured as having 0.5Ω resistance in the supply wire (therefore 1Ω, considering return too), which accounts closely with the example above.

Adding another 5m extender dropped the load voltage to almost 4.5V, with the PC then reporting "USB device not recognised", presumably because of timing and low supply voltage issues.

Given the lowered supply voltage at the end of these lengthy USB cables, it's feasible that heavier (paralleled?) DC supply cables could be used if longer runs are needed and data propagation timing is not an issue – perhaps to serve a rooftop USB webcam or "sweetspot" WiFi adaptor.

Some of the now-common external USB hard disks and CD/DVD writers actually have two USB connectors at the PC end, wired in parallel to achieve the currents required. They rely on the fact that (hopefully!) most PCs these days have several USB port sockets close together.

Remote DC supplies via completely separate lines and a 7805 voltage regulator, perhaps with higher voltage (9V?) initially, may serve to stretch runs as well.

This is precisely the scheme involved in the SILICON CHIP USB Power Injector mentioned above; however it also included line sensing to turn the power on and off in sympathy with the power at the USB port itself.

Perhaps even a small photovoltaic solar panel could be used to charge a rooftop battery, providing a regulated 5V supply. It's rather akin to "corporate" power over ethernet (POE) approaches – well known for rooftop/masthead WiFi Access Points energised via cheap CAT-5 cable.

SILICON CHIP's USB Power Injector from the October 2004 issue. It doubles the amount of power available from a USB port.

Aside from the tedious energy issues, ultimate cable lengths really are limited by the data speeds. Although such signals travel near the speed of light in cables, even a few extra metres of conductor can delay things unacceptably.

The recently-announced Wireless USB still only offers modest ranges (3-10m) but given the lack of wires(!), there certainly won't be any voltage drops – or convenient 5V supplies. Active Extender and doubled "Bus" power cables (Jaycar XC4839 and WC7750 respectively) may of course better suit demanding USB setups.

But if only modest extensions are needed, cheap passive extending techniques are well worth considering – if only to keep your coffee warm while lounging some distance away from the PC!

With the breakout adaptor shown above and a DMM, you can at least be easily informed of your loads' DC demands, something that currently is largely unknown. **SC**

* s.t.swan@massey.ac.nz

This active USB 5m extension cable uses some of the power available from the USB port to amplify the data signal. Up to 5 can be connected in series. It's from Jaycar (Cat XC4839).

Where you have power-hungry USB devices, a USB Bus Power Cable can give them a boost, connecting to two USB ports to double power. Also from Jaycar (Cat WC7750).

MANUFACTURERS OF LOW POWER RADIO MODULES ESTABLISHED SINCE 1985

25mW version available

The TDL2A is a 9600 baud half-duplex OEM radio modem in a BiM2 footprint. Provided no two devices attempt to transmit simultaneously, no further restrictions on data transmission need be made, as all transmit timing, valid data identification and datastream buffering is conducted by the unit. Synchronisation and framing words in the packet prevent the receiver outputting noise in the absence of signal or presence of interference.

- Multi-channel Wide Band FM radio modem
- 5 serial select channels on 433.05MHz-434.79MHz band
- Modulation: 16kbps bi-phase FSK
- Serial modem baud rate at 9600bps (halfduplex)
- Addressable point-to-point
- Data Present indication
- BiM2 footprint 33 x 23 x 7mm
- Performs low level packet formatting - preamble, synchronisation, bit balancing, error checking
- 32 byte data buffer
- Transmit power: +10dBm (10mW)
- Receiver sensitivity: -107dBm (for 1% BER)
- Supply: 5V @28mA transmit, 22mA receive/idle
- An interface board (with MAX232 type buffer, 9 way D connector, 5V voltage regulator and SMA RF connector) is available. This board is 61mm x 33mm in size

The TX1H and CVR1 form a miniature VHF radio transmitter and receiver designed for PCB mounting and are suitable for extended range data links at speeds up to 10kbps. Link ranges of 10km + are achievable with suitable choice of data rate and antennas.

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TX1H

- TX1H supply range: 3.8V-15V @80mA
- Transmit power: +20dBm(100mW) nominal
- Supply range: 3.8V - 15V @80ma
- Dimensions: 43 x 14.5 x 5mm

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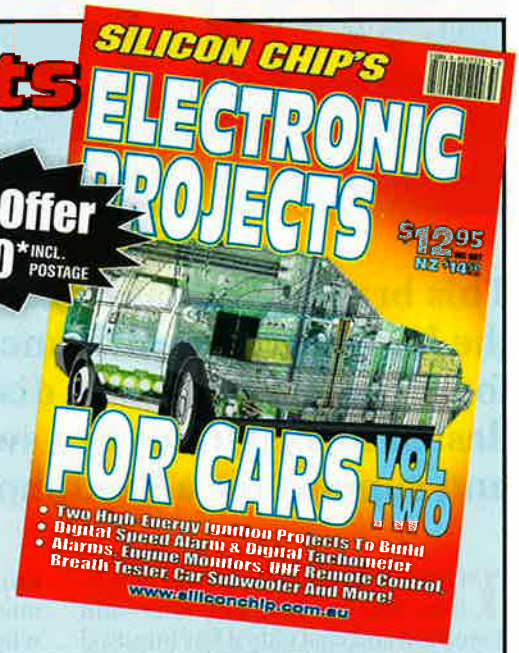
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By PETER SMITH

Studio Series Stereo Preamplifier

A Superb Preamplifier For The Audio Enthusiast!

This brand new, easy-to-build preamp features the latest high-performance audio op amps for ultra-low noise and distortion. Its modular design incorporates five switched RCA inputs and support for a headphone amplifier.

THESE DAYS, audio power amplifiers that produce low noise and distortion and cost only a few hundred dollars are relatively easy to find. In fact, they're built into many of the latest multi-channel home theatre systems. Much of this gear is based around hybrid amplifier modules, which typically produce distortion levels in the 0.02% realm.

Those serious about their audio will demand a much higher level of performance than can be found in these mass-produced units, which explains why the discrete power amplifier projects described in SILICON CHIP are so popular.

For example, the 15W Class-A Stereo Amplifier described in July and August 1998 still gets a high ranking, as does the 100W "Ultra-LD" class-AB design described more recently. These amplifiers are expensive to build but offer performance that typically costs many times more in comparable commercial units.

Having built one of our high-performance amplifiers, many readers have also asked us for a matching preamplifier design. And so our design brief was simple: a minimalist approach, focused on achieving ultra-low noise and distortion, but with enough gain (with the "wick" wound right up) to overdrive any of our audio power amplifiers, including the big 350W and 500W units. So, what were our options?

Discrete versus integrated

Initially, we were aiming for a discrete class-A amplifier design, speculating that this would be the best way to achieve the ultra-low distortion figures that were required. Another option was to use boutique op amps

specified for hifi audio use, such as those manufactured by Analog Devices and Texas Instruments.

High linearity and the lack of crossover distortion are the major reasons for the use of class-A mode in audio applications. However, when compared to an equivalent op amp design, a discrete class-A amplifier would have consumed a large amount of PC board space, making the completed module physically large and more prone to radiated noise. It would also be considerably more difficult to build, containing many more components than an equivalent op amp design.

We then looked at the current audio op amp offerings and their implementation. In many of our past designs, we've used the industry-standard NE-5534 and LM833 devices. These are relatively cheap and easy to obtain, and both typically produce about 0.002% total harmonic distortion (THD) at 1kHz when driving a 2kΩ load. Don't get us wrong – this is a very good figure – but it just wasn't good enough for our new preamp! Our intention was (and is) to produce a preamp which causes virtually no signal degradation when teamed with our benchmark class-A 15W amplifier.

From the limited selection of audio-specific op amps available, most were deemed either too expensive or too hard to obtain. However, the Burr-Brown (Texas Instruments) OPA134 series is not expensive and easy to obtain and it produces an extremely low 0.00008% harmonic distortion at 1kHz! This is more than an order of magnitude (25 times better!) below the figures for the op amps mentioned earlier and with all things considered, would give superior performance compared to a discrete class-A design.

Incidentally, the output stages of these op amps do not run in class-A mode, despite their excellent linearity. The manufacturer's datasheets do not reveal how they have achieved these impressive results.

Extra features

We've stuck to our minimalist brief and added just two features to the basic preamp. The first of these addresses a common problem faced during preamp construction: how to switch the various signal inputs through to the preamp input while maintaining low noise and crosstalk.

Typically, multiple inputs are handled by fitting a bunch of RCA sockets to the rear panel and laboriously wiring these to a rotary switch on the front panel with shielded cable. Alternatively, the RCAs are mounted on a PC board at the rear along with the switch, which is then piped through to the front panel with a long extension shaft. While these methods work, they have their disadvantages. What's more, they don't allow for remote control selection!

We've opted for an electro-mechanical solution, using passive (relay) switching for minimum impact on the audio signal. Each stereo input has its own miniature relay, positioned right next to the RCA socket. This gives absolute minimal source crosstalk and less induced noise, even when compared to some cabling schemes.

The second feature is closely related to requests we've had for a high-quality headphone amplifier that runs off the preamp (rather than power amp) stage. In support of this idea, we've included a relay circuit that can route the preamp's output to an RCA socket at the rear or a terminal block on the inside, where it would connect to a separate headphone amplifier board.

In summary, to operate as a fully functioning unit, the Studio Series Preamplifier module requires only a volume potentiometer, source selection switch and low-noise power supply, all of which are described in detail in this article.

Features & Performance

Main Features

- High performance design – very low THD+N
- Five on-board RCA inputs
- Passive-switched inputs maintain signal integrity
- Switched headphone amplifier output

Measured Performance

Frequency response	flat from 10Hz to 20kHz, -1dB @ 82kHz (see Fig.5)
Maximum input signal	2.9V RMS (9.5V RMS output)
Input impedance	~90kΩ
Output impedance	100Ω
Harmonic distortion	typically <.0005% (see Fig.7)
Signal-to-noise ratio	-102dB unweighted
Channel crosstalk	-96dB @ 1kHz, -73dB @ 10kHz
Source crosstalk	-110dB @ 1kHz, -93dB @ 10kHz

Note: all measurements were performed at the maximum volume setting with the output driving a 50kΩ load. Input signal amplitude was 600mV RMS (2V RMS output). For crosstalk measurements, non-driven inputs were back-terminated into 600Ω.

In the pipeline

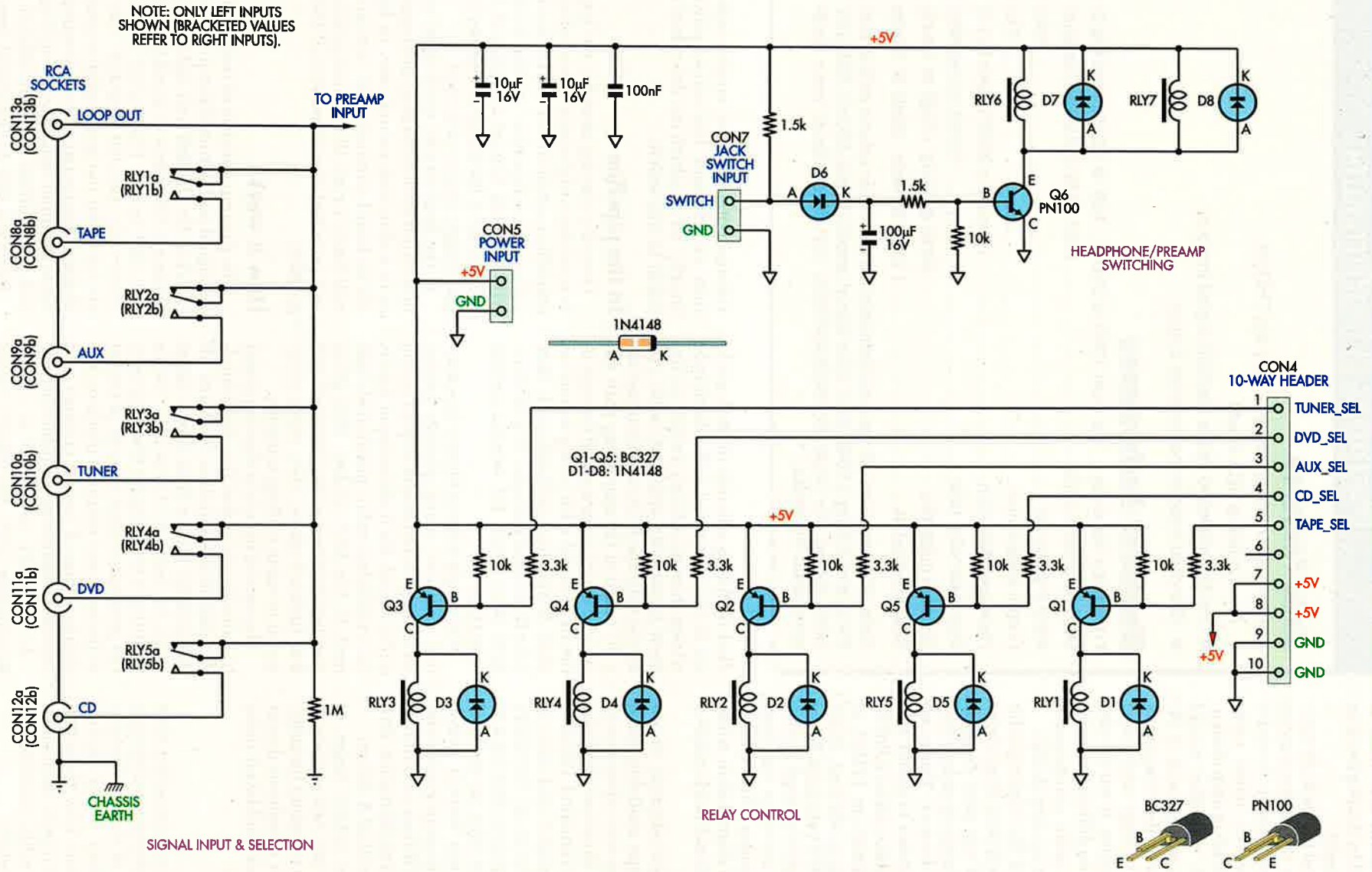
Over the coming months, we hope to describe a high-quality headphone amplifier module to suit. We're also developing a companion control board, which would feature an infrared remote control (motorised) volume pot and remote source selection.

In the final article, we'll show you how to put all of these modules together in a slim rack-mount case. In fact, we've heard rumours that Altronics will have a very nice screen-printed and punched case to accept all these goodies.

How it works

The preamp consists of two identical signal paths from input to output, catering for the left and right stereo channels. Therefore, to avoid duplication and reduce clutter, our circuits show only the left channel. We've also divided the preamplifier circuit diagram into two sections, corresponding to the input signal switching (Fig.1) and preamplifier functions (Fig.2).

Referring first to the signal inputs (Fig.1), no less than five RCA sockets



SC ©2005 STUDIO SERIES STEREO PREAMPLIFIER – SIGNAL INPUT & SWITCHING

Fig.1: the preamp's input and output switching circuits. Passive (relay) rather than active switching is used to have minimal effect on the audio signal. Any one of five RCA inputs can be selected by bringing the base of the associated relay driver transistor to ground.

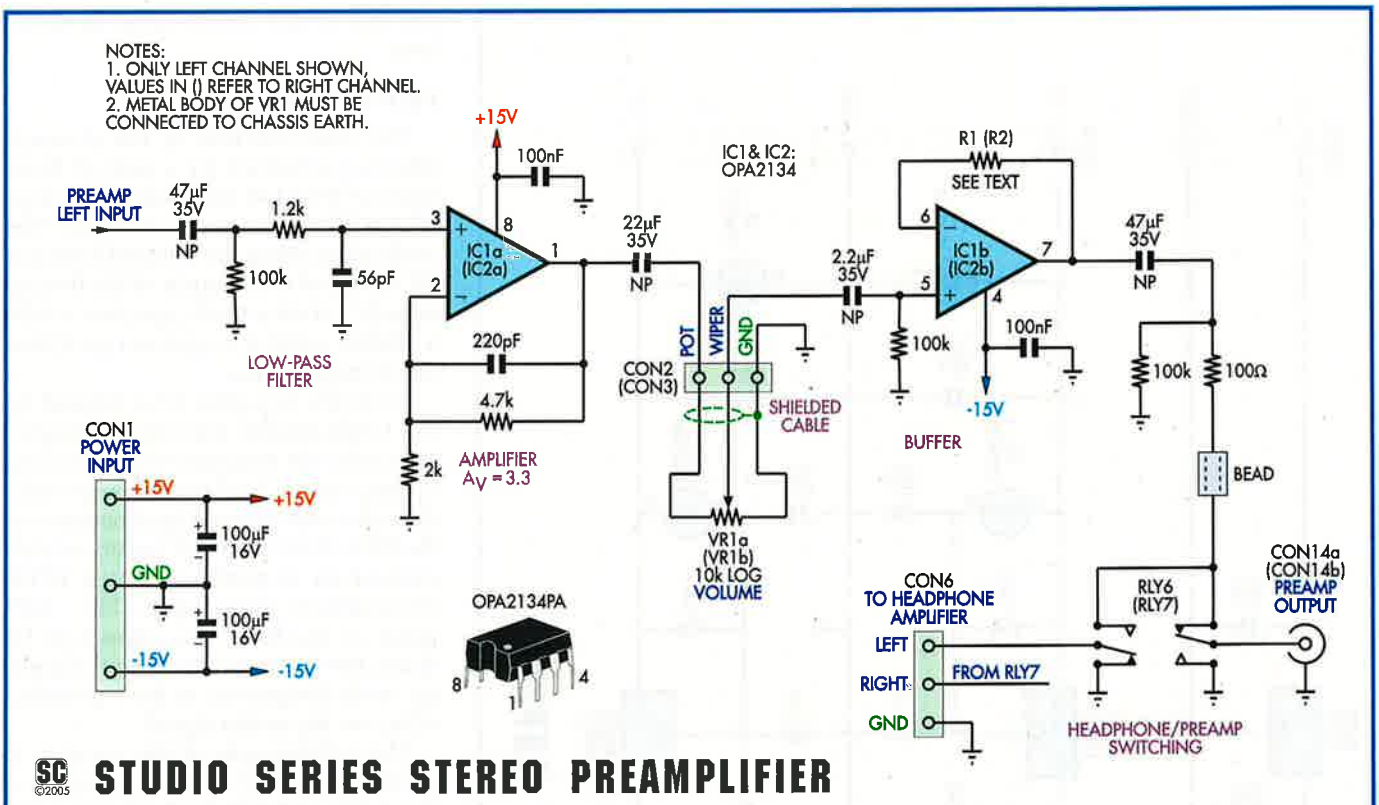


Fig.2: the amplifier part of the preamp is based on Burr-Brown high-performance OPA2134 audio op amps (IC1 & IC2). To save space, only the left audio channel is shown here – the right channel is identical.

(CON8-CON12) are provided for connection to various audio sources. We've used labels such as "CD", "DVD" and "TAPE", but of course, these inputs will accept any audio signal classed as "line-level". The sixth socket (CON13) simply loops the selected input pair back out, duplicating the "tape loop" function found in some preamps and control units.

Each input pair is connected to the normally-open contacts of a relay, with the poles of all relays connected together. The relays are driven with PNP transistors (Q1-Q5) from the +5V rail, such that when the base of a transistor is pulled to ground it switches on, energising the relay. This closes the relay contacts and connects the signal pair through to the amplifier input.

We have not used the normally closed contacts of the relays. With a slightly different switching arrangement we could have used these to short the outputs of the "unselected" program sources to ground. For example, this would stop the audio from a tuner being heard at low levels when a CD player was selected. This approach would have ensured low source crosstalk but we felt that shorting some program sources may not be desirable. In any case, we have managed to keep source crosstalk very low, at around -110dB.

The bases of Q1-Q5 are connected to a header (CON4) via 3.3kΩ resistors, so it's simply a matter of grounding the designated header pin to select a particular signal source. A rotary switch can be used to perform this function, as shown in Fig.3.

Note that the relay control circuits operate from completely separate power and ground rails. In fact, we've used a different ground symbol for the relay circuits to indicate that this rail is not connected to the amplifier ground rail on the preamp PC board. Instead, the two ground rails are connected only on the power supply board to minimise noise.

Also shown on this circuit (Fig.1) are the coils for relays RLY6 & RLY7 and their control circuit. These form part of the preamplifier's output signal

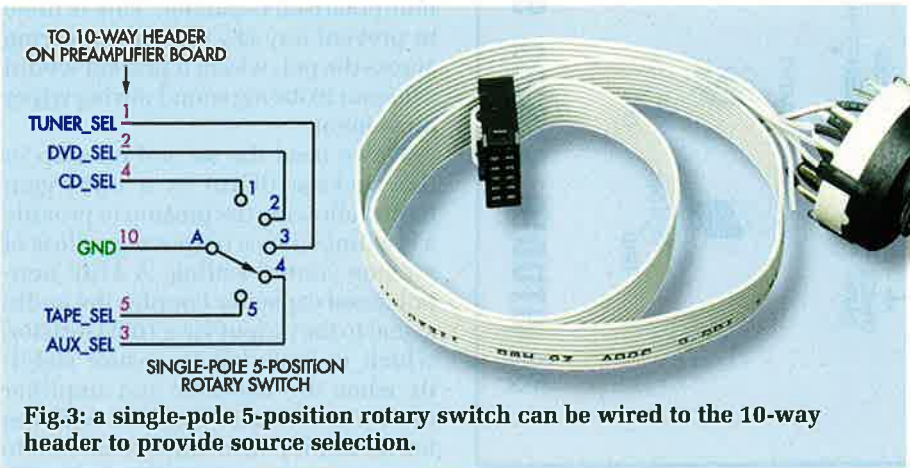


Fig.3: a single-pole 5-position rotary switch can be wired to the 10-way header to provide source selection.

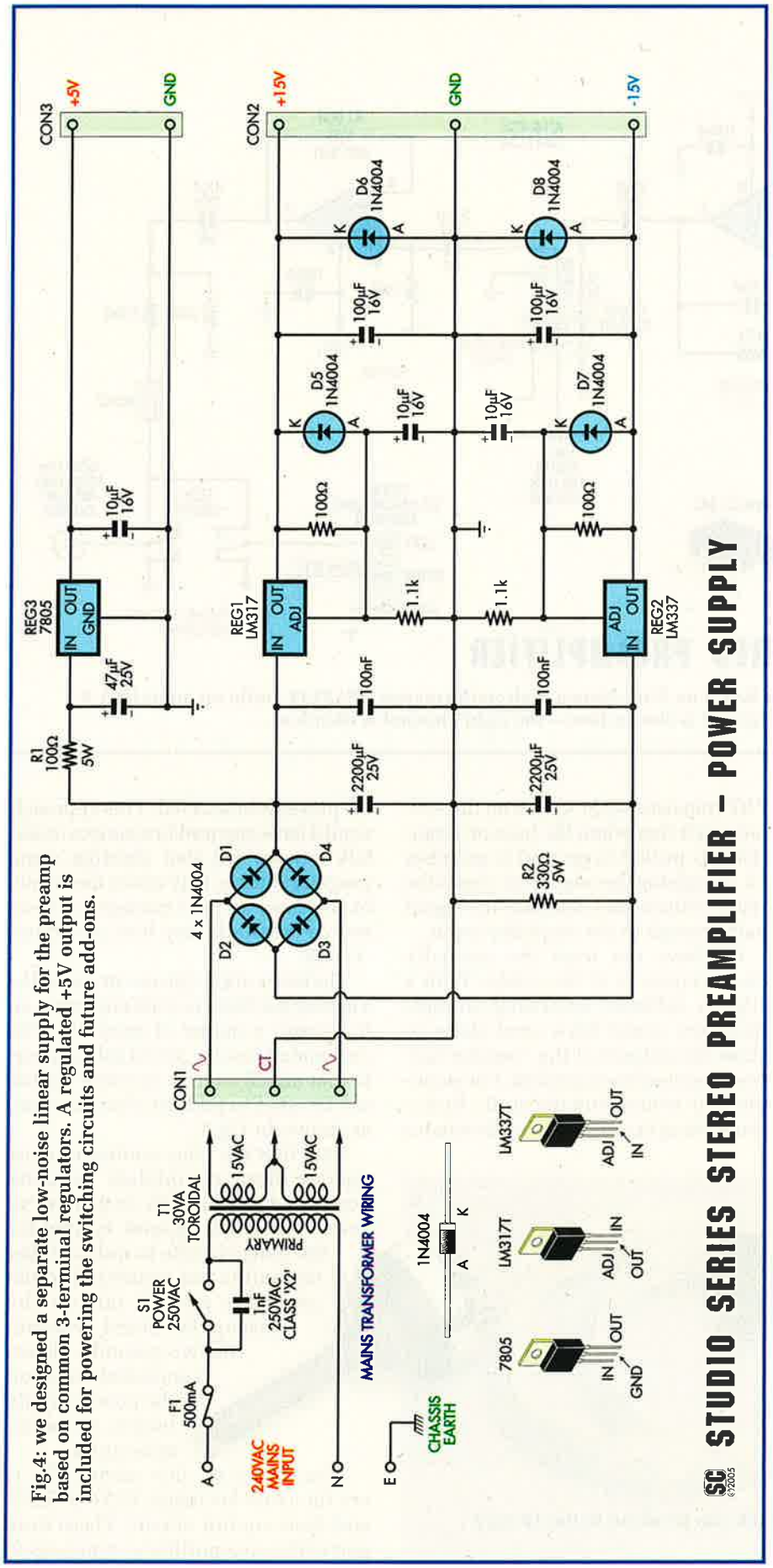


Fig.4: we designed a separate low-noise linear supply for the preamp based on common 3-terminal regulators. A regulated +5V output is included for powering the switching circuits and future add-ons.

routing, which we describe in detail later.

FET op amps

The core function of the preamplifier is performed by a pair of Burr-Brown OPA2134 dual audio op amps (IC1 & IC2), as shown in Fig.2. The audio signal from the selected source is AC-coupled to the input of the first op amp (IC1a) via a 47µF capacitor, while a 100kΩ resistor to ground provides input termination.

A simple low-pass filter formed by the 1.2kΩ resistor and 56pF capacitor attenuates RF frequencies ahead of the op amp input. A relatively large resistor value can be used here because of the OPA2134's true FET inputs, which present an impressively large 10TΩ (Teraohms!) impedance. The -3dB point of the filter was chosen to be about 100 times greater than the highest audio frequency, to have minimal effect on the audio signal.

The voltage gain of the op amp is set to about 3.3 (10.5dB) by virtue of the 4.7kΩ and 2kΩ feedback resistors. The 4.7kΩ resistor and 220pF capacitor combination roll off the top end frequency response, with a -3dB point at 154kHz.

As can be seen from the frequency response graph (Fig.5), this gives a flat response over the audio spectrum while eliminating the possibility of high-frequency instability.

The output from IC1a (pin 1) drives one end of a 10kΩ potentiometer (VR1a) via a 22µF non-polarised coupling capacitor. The pot acts as a simple voltage divider, with more of less of the amplified signal appearing at the input of the second op amp (IC1b), dependent on wiper position.

You'll note that the wiper of the pot is also AC-coupled, again with a non-polarised capacitor. This is done to prevent any DC voltage appearing across the pot, which if present would cause an irritating sound during wiper movement.

We've used the second op amp in the package (IC1b) as a unity-gain buffer, allowing the preamp to provide a low-impedance output regardless of volume control setting. A 47µF non-polarised capacitor couples the audio signal to the output via a 100Ω resistor, which is included to ensure stability when driving cable and amplifier input capacitance. Together with the ferrite bead, it also helps to attenuate

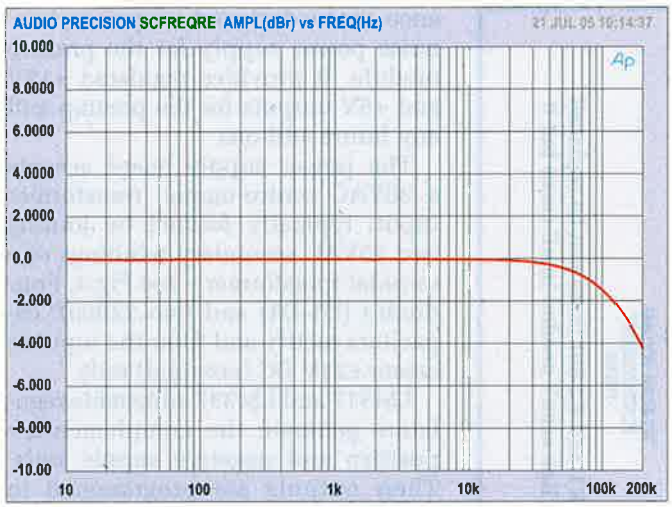


Fig.5: a plot of the frequency response for both channels shows a ruler-flat response over the entire audio spectrum, after which the curve gently rolls off, with a –3dB point at 154kHz.

Fig.6: crosstalk between channels is also very respectable. Increasing crosstalk at the higher end of the scale indicates electrostatic coupling, due to the physical proximity of the channels and the long PC tracks connecting the relays.

RF noise that might otherwise find its way back into the preamp circuit.

Impedance matching

As mentioned, op amp IC1b is configured for unity gain, so its output (pin 7) must connect back to its inverting input (pin 6). Note, however, that we show a resistor (R1) in the feedback path. Those familiar with op amps will know that a resistor can be included in this loop to impedance match the two inputs.

Like many op amps, the OPA2134 shows an increase in distortion in non-inverting applications if the impedance seen by its positive and negative inputs is not matched. Unfortunately, the input impedance that the negative input of IC1b "sees" varies with the wiper of the pot.

Despite this shortcoming, the distortion levels of the OPA2134 are very low even at the worst case wiper position, where noise far outweighs distortion anyway. Nevertheless, we've provided positions on the PC board for two impedance-matching resistors (R1 & R2).

If desired, you can install equal value resistors (instead of wire links) in these two locations that approximate the wiper-to-ground resistance of the volume pot at your typical listening levels. This extra little feature allows you to obtain the very best performance from your preamplifier module!

Of course, the said wiper resistance can only be determined after you've used the preamp with your complete stereo system and favourite music for awhile, so wire links are installed in these locations during construction. We suspect that most constructors won't bother to replace the wire links!

Output switching

Finally, provision has been made to allow the preamp output to be switched between the RCA socket pair at the rear (CON14) and a terminal block (CON6). The latter connector is intended for use with an internal high-quality headphone amplifier, presently under development.

Two relays (RLY6 & RLY7) are used to allow the non-driven input to be grounded. Relay operation is dictated by the insertion and removal of the headphone jack, which operates a switch inside the jack socket.

The jack switch is wired to CON7 (Fig.1), where it controls transistor Q6 to drive the two relay coils. With a jack in the socket, the switch is open and the base of Q6 is pulled high via diode D6 and the two 1.5kΩ resistors. This turns Q6 on and energises both relay coils, directing the output signal to CON6 and the headphone amplifier.

When the jack is unplugged, the socket switch closes, grounding the "SWITCH" input on CON7 and stealing Q6's base current. After a short delay, the transistor (and the relays) switch off, redirecting the output signal to CON14 and the power amplifier.

The diode, capacitor and resistors are included in the base circuit of Q6 to slow the circuit's response to changes at the switch input. This helps to minimise relay chatter during jack insertion and removal.

Power supply

To ensure the best possible perform-

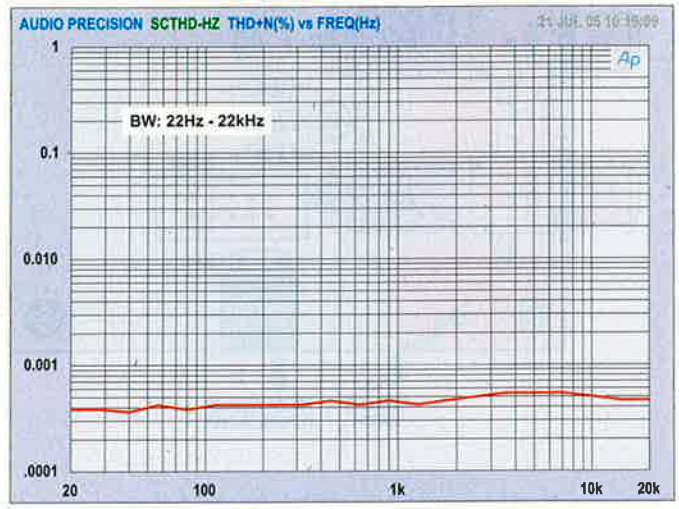


Fig.7: all our audio tests were performed in-house on our Audio Precision System One. This graph shows total harmonic distortion & noise versus frequency. The reading is mostly below .0005%. However, this figure is barely above the noise floor of the test instrument, so the real value is probably much lower!

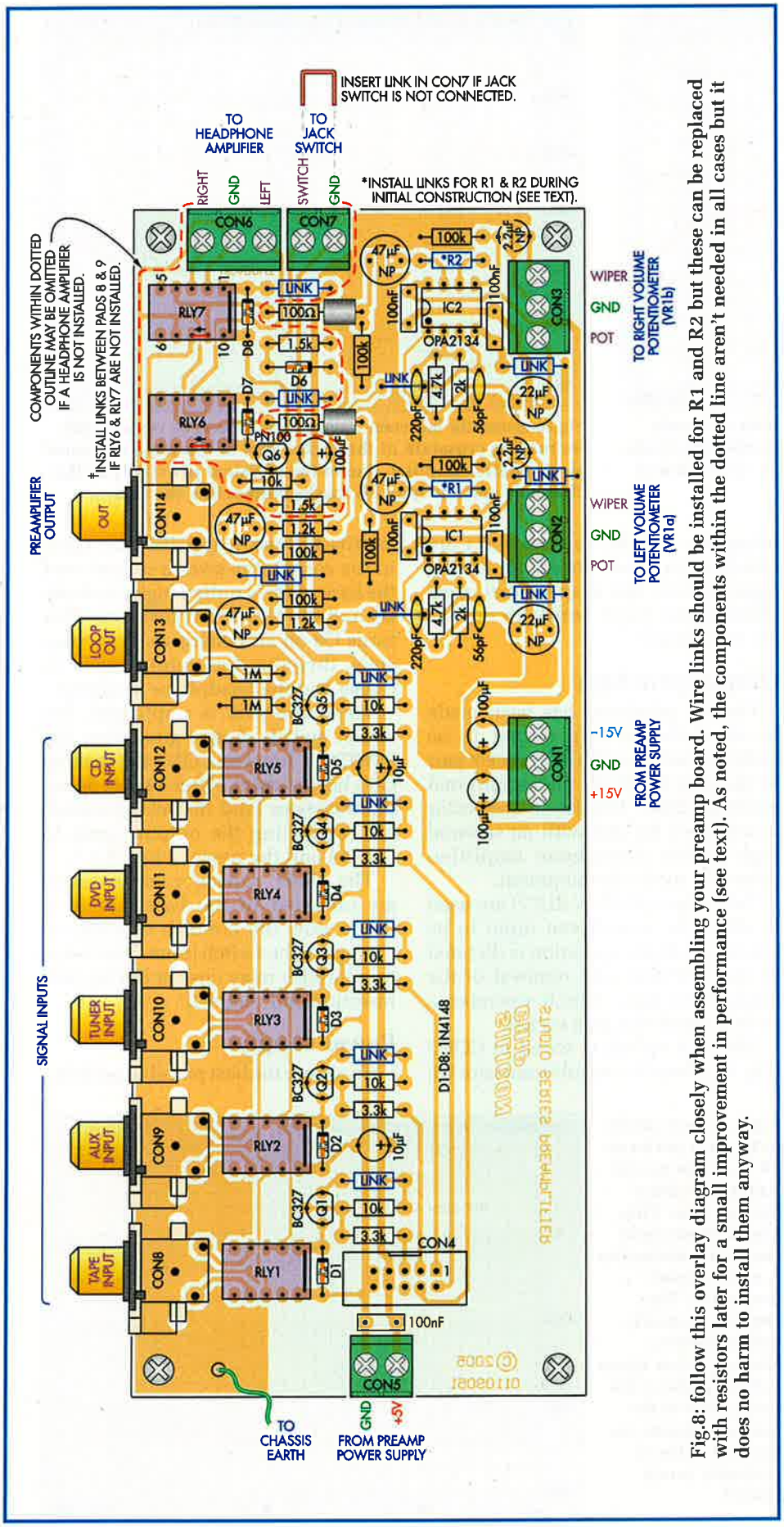


Fig.8: follow this overlay diagram closely when assembling your preamp board. Wire links should be installed for R1 and R2 but these can be replaced with resistors later for a small improvement in performance (see text). As noted, the components within the dotted line aren't needed in all cases but it does no harm to install them anyway.

ance, we've designed a separate, low-noise power supply for the preamp module. It provides regulated ±15V and +5V outputs for the preamp and any future add-ons.

The power supply board accepts a 30VAC centre-tapped transformer input, typically formed by joining two 15VAC secondary windings of a toroidal transformer – see Fig.4. Four diodes (D1-D4) and two 2200µF capacitors rectify and filter the input to create ±21V DC (nominal) rails.

LM317 and LM337 adjustable regulators generate the complementary positive and negative supply rails. Their outputs are programmed to ±15V by virtue of the 100Ω and 1.1kΩ resistors connected to the "OUT" and "ADJ" terminals.

We've used adjustable regulators in this design because the "ADJ" terminals can be bypassed to ground to improve ripple rejection, which we've done using 10µF capacitors. The associated diodes (D5 & D7) provide a discharge path for the capacitors should an output be accidentally shorted to ground.

Two reverse-connected diodes (D6 & D8) across the output prevent their respective rails from being driven to the opposite polarity (eg, if a regulator fails), something that should never occur during normal operation.

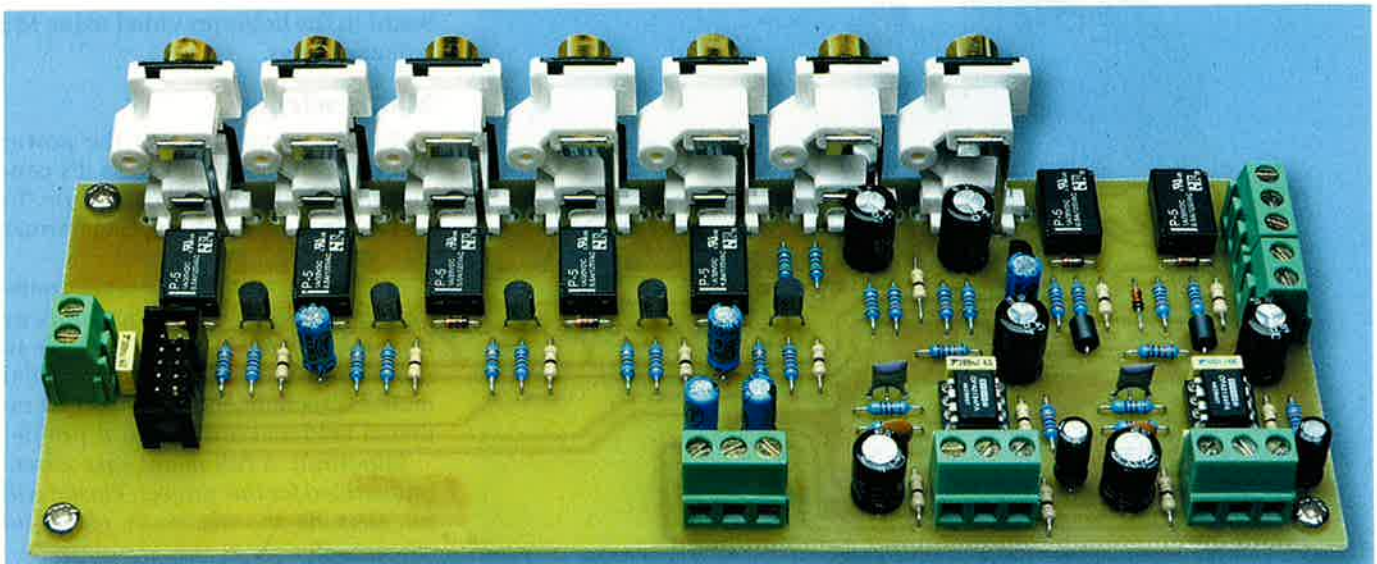
A 7805 regulator (REG3) is used to generate the +5V rail. The 100Ω resistor in line with REG3 reduces power dissipation in the regulator. While this resistor is not strictly necessary when powering only the preamp module, it will certainly be required for future add-ons, which will demand considerably more current!

As the +5V supply draws power from only the positive side of the unregulated DC input, a 330Ω resistor across the negative input is included to balance the rails so that they decay at similar rates at power off.

Preamp assembly

Assembly of the preamplifier board is quite straightforward, as all components (except for the volume pot) mount on a single-sided PC board measuring 73 x 192mm. Use the overlay diagram in Fig.8 as a guide to component placement.

If you won't be connecting a headphone amplifier to the board later on, then installation of the associated output switching circuitry is optional.



This prototype preamp board varies slightly from the final version shown in Fig.8. The miniature relays switch the selected source to the preamp stages and switch the preamp output between the external power amplifier and an optional internal headphone amplifier (to be described in a coming issue).

The components involved are RLY6, RLY7, CON6, CON7, D6-D8, Q6, a 100µF capacitor and a few resistors. Fig.8 shows these items enclosed within a dotted outline, for easy identification.

You'll find assembly much easier if you install the wire links, resistors and diodes first. Note that two of the wire links pass partially beneath the 220pF capacitors and these must be fashioned from 0.7mm tinned copper wire or similar.

Zero ohm "resistors" can be used in place of wire links in the remaining 11 positions, if desired. These are shaped just like conventional 0.25W resistors and are identified by their brown body and single black band. Although they impart a neater appearance to the finished work, they have no electrical benefits over ordinary copper wire! For the time being, you should also install wire links in place of resistors R1 & R2.

Note that the two 100Ω resistors require special treatment. Slip a 5mm ferrite bead over one lead before bending and inserting each resistor into its PC board holes.

The relays (RLY1-RLY7) can go in next, taking care to insert them the right way around. The white line on the top of the package must match the corresponding marking on the overlay diagram. Remember that RLY6 & RLY7 can be left out if headphone amplifier switching isn't needed, as explained earlier. However, you must fit two wire links in place of the relays, as shown in Fig.8.

Install the two 8-pin IC sockets and the 10-way header (CON4) next. Note that one side of the header housing is keyed and this must be oriented towards the centre of the board. Likewise, the notched (pin 1) end of the IC sockets must be correctly oriented.

Follow with the screw terminal blocks, all of the capacitors and the transistors. Five of the electrolytic capacitors (100µF & 10µF values) are polarised and must be installed with their positive leads aligned as shown. The remaining electrolytics are non-polarised (marked "NP" or "BP") and can go in either way.

The RCA connectors (CON8-CON14) go in last of all. Be sure to push each connector all the way home and check that it's sitting perpendicular to the board surface before soldering.

Power supply assembly

The power supply PC board is a relatively simple design and should not present any particular assembly problems. Apart from the mains transformer and wiring, all components mount on a single-sided PC board measuring 54.6 x 80mm, including the bridge rectifier, filters and voltage regulators.

As before, install all of the low-profile components first, starting with the single wire link, resistors and diodes (see Fig.10). To aid heat dissipation, the two 5W resistors should be mounted about 2mm proud of the board surface.

Take care with the orientation of the electrolytic capacitors, as all on this board are polarised. Also, be sure not to interchange the two adjustable regulators (REG1 & REG2) and note that they face in opposite directions!

Unlike REG1 & REG2, regulator REG3 mounts horizontally. Bend its leads at 90° about 5mm from its body and trial fit it in position to verify that

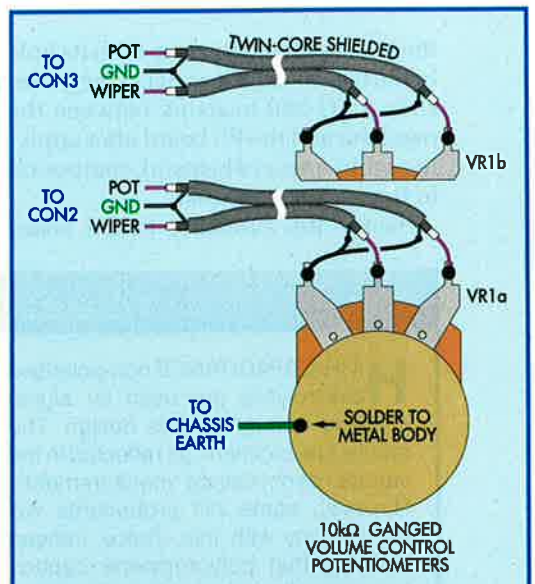
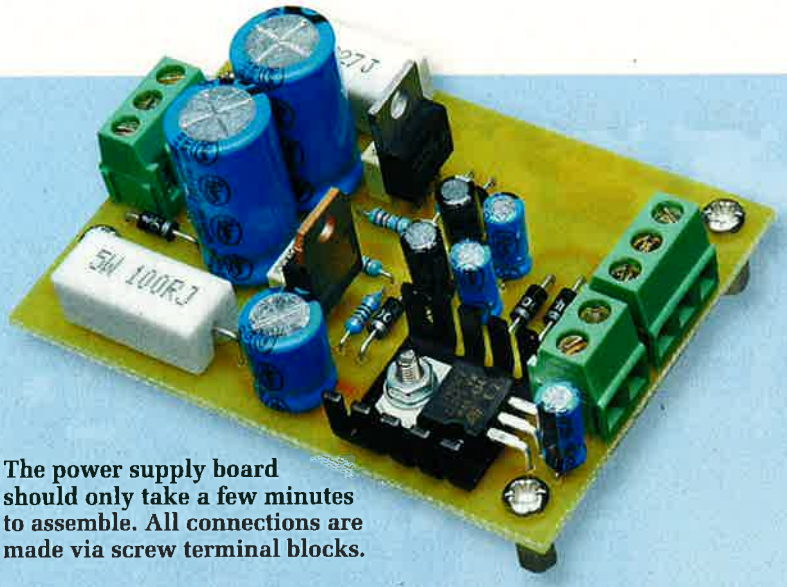


Fig.9: here's how to wire both halves of the dual-gang volume pot. We plan to present a motorised volume control in a future instalment. If you can't wait, then check out the Infrared Remote Volume Control published in June 2002.



The power supply board should only take a few minutes to assemble. All connections are made via screw terminal blocks.

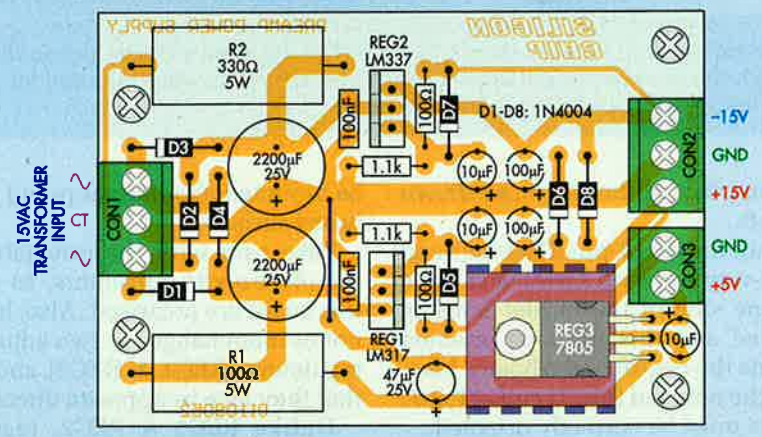


Fig.10: follow this diagram to assemble the power supply board. Take care not to get the 3-terminal regulators mixed up.

the hole in the tab lines up with its hole in the board. Adjust as necessary, then slide a TO-220 heatsink between the regulator and the PC board after applying a thin smear of heatsink compound to the mating surfaces.

Secure the assembly to the board with an M3 x 10mm screw, flat washer & nut. Don't solder the regulator's leads until after the screw has been tightened, otherwise the PC board or regulator package could be damaged.

Before moving on to the wiring, attach four threaded standoffs to each board in the holes provided using M3 x 6mm screws.

Mains wiring

It's very important that the power supply is checked out before it's connected to the preamplifier module. To do this, first assemble the transformer into your metal project case.

For best results, the mains transformer should be located as far away from the preamp board as possible to minimise induced noise. A toroidal model is recommended for its low radiated field and low physical profile.

Important: a full metal case is recommended for this project. Plastic will not provide the necessary electrical screening!

Connect the mains (primary) side of the transformer, using the basic diagram in Fig.4 as a guide. Be sure to adhere to any instructions provided with the transformer, particularly with regard to mounting, fuse ratings and wire colour coding.

All work must be carried out professionally and in accordance with mains wiring practices. In particular, ensure that all live connections are properly insulated, which includes the use of rubber boots (or equivalent) over the rear of all switches and mains sockets.

The mains wiring is not complete until the mains earth is secured to the metal chassis using the scheme shown in Fig.11. That done, use your multimeter to verify that a good electrical connection exists between the earth pin of the mains plug and all panels of the metal chassis.

Power supply test

The power supply test is uncompli-

Electrolytic vs Polypropylene Capacitors

HIGH-CAPACITANCE non-polarised electrolytics are used for signal coupling throughout this design. The results are excellent, as reflected in the various performance measurements. However, some hifi proponents will be unhappy with this choice, instead insisting that polypropylene capacitors somehow "sound" better than electrolytics when used in the audio signal chain.

To explain, polypropylene capacitors have a much lower dissipation factor (DF) and lower dielectric absorption (DA) than electrolytics; a major reason for their use in sample-and-hold circuits, high-frequency filter networks and speaker crossovers, for example. However, their benefits in low-level audio frequency circuits are much harder to quantify, especially considering their proportionally larger size, higher cost and limited local availability in appropriately large values.

Those with a personal preference for polypropylene capacitors can of course substitute these for the specified non-polarised electrolytics, given sufficient board space and part availability. Smaller capacitance values will need to be used for polypropylene substitutes due to the sheer size and cost differences. To minimise impact on bass response, a minimum of 2.2µF should be substituted for the 47µF and 2.2µF electrolytics and a 4.7µF value for the 22µF electrolytic. It would also be preferable to use a 20kΩ log pot for VR1.

Note that the use of physically larger coupling capacitors is likely to increase noise and crosstalk.

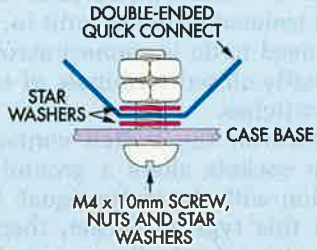


Fig.11: the mains earth terminal is secured to the case as shown here. The top nut serves as a lock-nut, so that the assembly cannot possibly come loose.

cated and involves simply measuring the unloaded output voltage of the three supply rails. To do this, first connect the two secondary (15VAC) windings to the transformer input (CON1) of the board.

Apply power and use your multimeter to measure the three rails at the supply outputs (CON2 & CON3). Assuming all is well, the +15V, -15V and +5V rails should all be within ±5% of the rated values.

Low-voltage wiring

Once you're satisfied that the power supply is working properly, disconnect input power and wire up the ±15V and 5V outputs to the preamp supply inputs. Note that these supplies must be cabled separately, meaning that two wires are required for the 5V supply (+5V & GND) and three for the ±15V supply (+15V, -15V & GND).

Use medium-duty, multi-strand hook-up wire for the job and twist the wires tightly together to reduce noise and improve appearance. Again, run the cable for the 5V supply separately; do not twist it together with the ±15V wiring.

For most installations, the preamp's common (GND) rail should be connected to chassis earth. This is achieved by running a wire from the pad marked "EARTH" on the preamp board to the main chassis earth point. Do not connect any other part of the preamp circuit or power supply to chassis earth (except the volume pot, see below).

The volume pot must be a dual-gang logarithmic type, preferably 10kΩ in value. If using a motorised pot, a 20kΩ value may have to suffice. Don't use a larger value, as this will affect the preamp's noise performance. Do use twin-core shielded cable for each section of the pot, wired as shown in Fig.9!

The metal body of the pot must be connected to chassis earth to reduce noise pickup. Do not connect the body to either of the shielded cables! Normally, the front panel will provide the necessary earth connection. If

Parts List

1 PC board coded 01109051, 73mm x 192mm
7 DPDT 5V DIL relays (RLY1-RLY7) (Altronics S 4128B)
7 PC-mount gold-plated dual RCA sockets (CON8–CON14) (Altronics P 0212)
1 10-way 2.54mm PC mount shrouded header (CON4) (Altronics P 5010)
4 3-way 5mm/5.08mm terminal blocks (CON1-CON3, CON6)
2 2-way 5mm/5.08mm terminal block (CON5, CON7)
2 5mm ferrite beads (L1, L2) (Altronics L 5250A)
2 8-pin gold-plated IC sockets
4 M3 x 10mm tapped spacers
4 M3 x 6mm pan head screws
7 self-tapping screws (for RCA sockets)

Semiconductors
2 OPA2134PA dual FET-input op amps (IC1, IC2) (Farnell 791-039)
5 BC337 PNP transistors (Q1-Q5)
1 PN100 NPN transistor (Q6)
8 1N4148 diodes (D1-D8)

Capacitors
3 100µF 16V PC electrolytic
2 10µF 16V PC electrolytic
4 47µF 35V/50V non-polarised PC electrolytic (max. 8mm diameter)
2 22µF 35V/50V non-polarised PC electrolytic (max. 8mm diameter)
2 2.2µF 35V/50V non-polarised PC electrolytic (max. 5mm diameter)
5 100nF 50V metallised polyester (MKT)
2 220pF 50V ceramic disc
2 56pF 50V ceramic disc

Resistors (0.25W 1%)

2 1MΩ	2 2kΩ
6 100kΩ	2 1.5kΩ
6 10kΩ	2 1.2kΩ
2 4.7kΩ	2 100Ω
5 3.3kΩ	13 0Ω (for links)

Additional items
1 dual-gang 10kΩ log potentiometer
1 single-pole 5-position rotary switch (eg, Altronics S 3021)
1 10-way IDC cable-mount socket
10-way IDC ribbon cable
2-core shielded audio cable for volume pot connections
Medium-duty hook-up wire for low-voltage wiring

Power Supply
1 PC board coded 01109052, 54.6 x 80mm
1 Micro-U 19°C/W TO-220 heatsink (Altronics H 0637)
2 3-way 5mm/5.08mm terminal block (CON1, CON2)
1 2-way 5mm/5.08mm terminal block (CON3)
4 M3 x 10mm tapped spacers
5 M3 x 6mm pan head screws
1 M3 nut & flat washer

Semiconductors
1 LM317T adjustable positive regulator (REG1)
1 LM337T adjustable negative regulator (REG2)
1 7805 +5V regulator (REG3)
8 1N4004 diodes (D1–D8)

Resistors
2 1.1kΩ 0.25W 1%
2 100Ω 0.25W 1%
1 330Ω 5W 5%
1 100Ω 5W 5%

Capacitors
2 2200µF 25V PC electrolytic
2 100µF 16V PC electrolytic
1 47µF 25V PC electrolytic
3 10µF 16V PC electrolytic
2 100nF 50V metallised polyester (MKT)

Additional items:
1 15V+15V 30VA toroidal transformer
1 Mains switch and connection hardware

OPA134 Series High-Performance Audio Op Amps

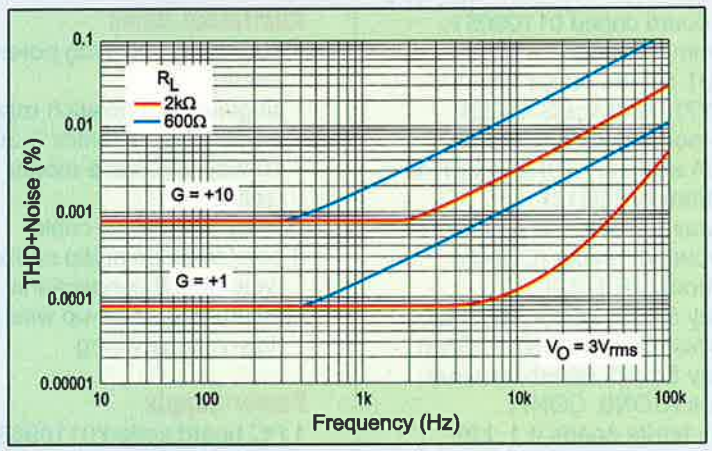


Fig.12: at unity gain, the THD+N performance for these op amps is almost invisible and certainly inaudible! This graph is reproduced from the datasheets, which can be obtained from the Texas Instruments website at www.ti.com.

THE OPA134 series op amps include single (OPA134), dual (OPA2134) and quad (OPA4134) versions. The series is fully specified for audio applications, boasting ultra-low distortion and low noise. They include true FET input stages to provide superior sound quality and speed for exceptional audio performance.

This in combination with high output drive capability and excellent DC performance allows use in a wide variety of demanding applications. In addition, the OPA134's wide output swing, to within 1V of the rails, allows increased headroom, making it ideal for use in any audio circuit.

OPA134 op amps are easy to use and free from the phase inversion and overload problems often found in common FET-input op amps. They can be operated from ±2.5V to ±18V power supplies. Input cascode circuitry provides excellent common-mode rejection and maintains low input bias current over its wide input voltage range, minimising distortion.

These op amps are unity-gain stable and provide excellent dynamic behaviour over a wide range of load conditions, including high load capacitance. The dual and quad versions feature completely independent circuitry for lowest crosstalk and freedom from interaction, even when overdriven or overloaded.

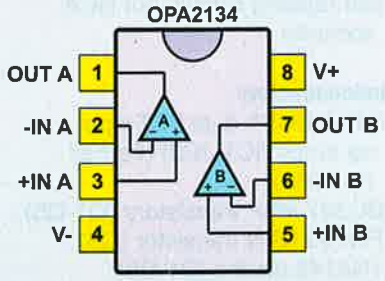


Fig.13: our preamp uses the OPA2134 (dual) version, which follows the industry-standard package configuration.

Another strong characteristic of this series is its extremely low signal distortion. Total harmonic distortion plus noise (THD+N) is below 0.0004% throughout the audio frequency spectrum (20Hz to 20kHz) with a 2kΩ load. In fact, the THD+N produced by these op amps is below the normal measurement limit of all known commercially available test instruments!

it doesn't, then connect the pot to a convenient chassis earth point using hook-up wire. Note that solder won't adhere to the plating on the pot, so remove a small area of the plating with an ink rubber or scouring pad prior to tinning.

If you've installed the headphone amplifier switching circuitry (RLY6, RLY7, etc) and have a suitable amplifier board, then connect the headphone audio output (CON6) to the input of your headphone amplifier using twin-core shielded cable.

In addition, the switch contacts of the headphone jack socket must be wired to CON7. Many jack sockets have isolated switches built in, so all you need to do is connect across the normally-closed terminals of one of the switches.

However, the switch contacts in some sockets share a ground connection with the audio signal. If you have this type of socket, then find the contact that is disconnected from ground when the jack is inserted and connect this back to the "SWITCH" input of CON7, leaving the "GND" input disconnected. This avoids creating a certain earth loop in your system!

Important: if the headphone jack switch isn't connected to the preamp board, then you must insert a shorting link between the two terminals of CON7; otherwise, you'll get no signal from the RCA output (CON14)!

Source selection

As mentioned earlier, each RCA input pair is individually selectable via one control line on the 10-way header (CON4). To select a particular input, simply connect the associated control line to ground (GND).

While we intend to describe a means of remotely controlling the preamplifier's source switching (and volume!) in a future issue of SILICON CHIP, a far cheaper and simpler method is to use a mechanical switch. All that's required is a single-pole 5-way rotary switch, a 10-way IDC cable-mount socket and a length of IDC cable.

As the cable doesn't carry low-level audio signals, it can be routed anywhere you like within your case without regard to length. The equivalent electrical circuit for the switch wiring is given in Fig.3.

Final checks

Before connecting inputs and outputs, power up and with your negative meter probe touching a handy ground point, measure the voltage on the power supply pins of the two op amps. Obviously, pin 8 should measure +15V and pin 4 should measure -15V. In addition, the outputs (pins 1 & 7) of both op amps should be within a few mV of ground.

Finally, if you've connected a source selection switch, you should be able to hear the relays clicking when you rotate the knob.

OK, that's it – you should now have a working hifi preamp! Happy listening! SC

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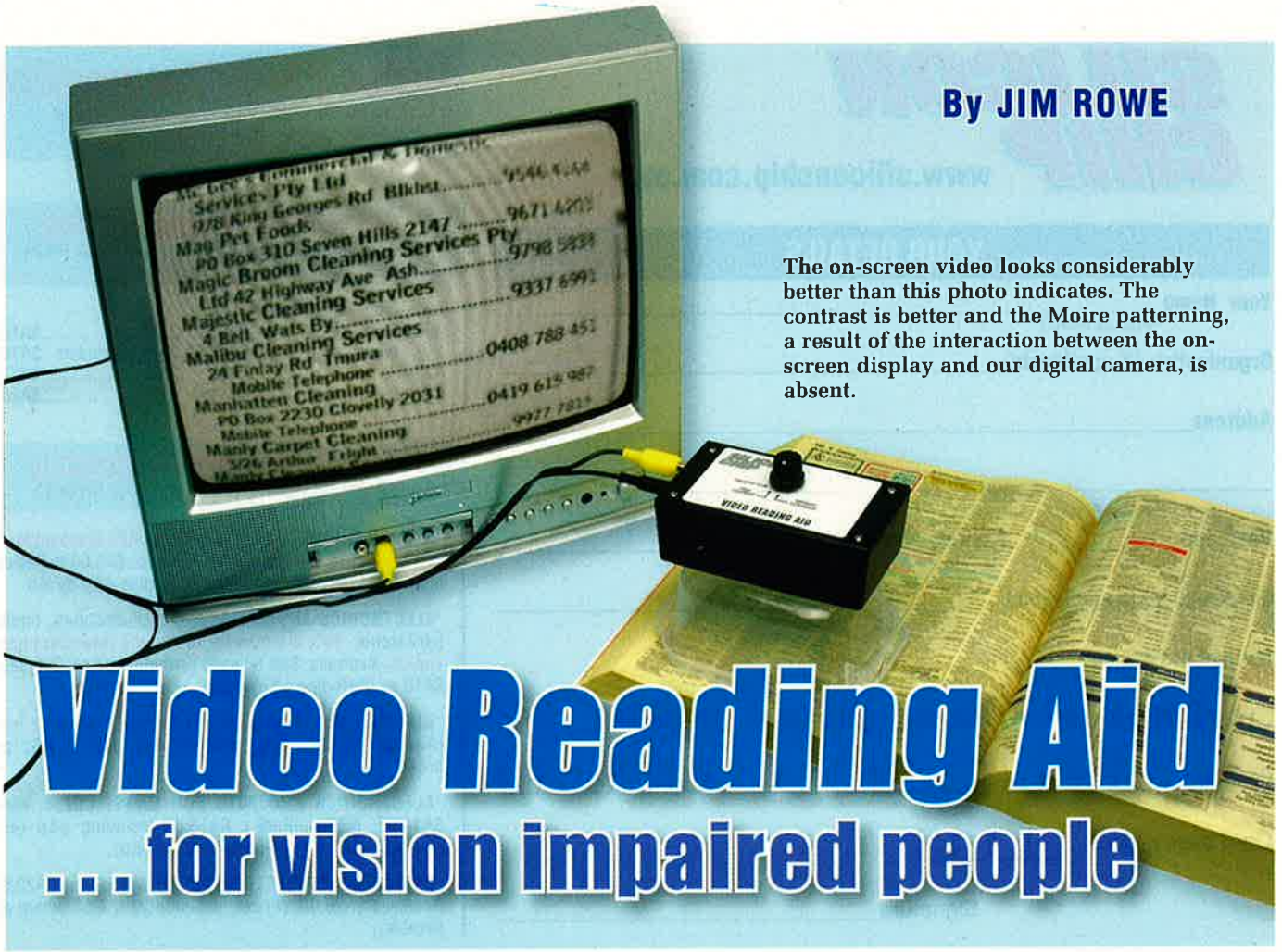


Video Reading Aid

...for vision impaired people

By JIM ROWE

The on-screen video looks considerably better than this photo indicates. The contrast is better and the Moire patterning, a result of the interaction between the on-screen display and our digital camera, is absent.

Do you have a family member with vision problems – like cataracts, or age-related macular degeneration? Here's a low-cost video reading aid that will make it much easier for them to read a book or newspaper. It combines a small CMOS TV camera with a video processor which boosts the contrast and allows them to select either a positive or negative enlarged image for viewing on a TV set or video monitor.

EYE PROBLEMS like cataracts and age-related macular degeneration are all too common in Australia, especially among those of "mature age". In fact, it was recently estimated that one in every four people over 75 has symptoms of this kind of visual impairment, while one in every 10 lose their central vision.

Understandably, those unlucky enough to suffer from these problems can find it very difficult to read a book, magazine or newspaper. This lowers their quality of life dramatically and deprives them of important sources of news, entertainment and information.

In many cases, however, reading printed material can be made a lot easier by using improved lighting to increase the contrast, plus a magnification system to enlarge the type. Optical magnifiers with built-in lighting are available for use as reading aids but they're fairly pricey. You can also get similar devices using video magnification but these are even more expensive. As a result, such devices are often out of the reach of the people who could benefit from them.

Recently, we decided to have a go at a video magnifier ourselves and this project is the result. It combines one of the very small low-cost black and white CMOS cameras currently available from various suppliers with a very compact video processing circuit, and has a switch so you can select one of three image options: high contrast greyscale positive, hard limited or 'digital' black and white positive, or digital negative. And the output is

standard video so it's compatible with any normal PAL TV receiver.

The camera and video processor are both fitted inside a standard UB3-size project box. Because a person with impaired vision doesn't want to be fiddling with camera focusing, we've mounted it on plastic food container to give it a fixed focal length. In use, this plastic skirt sits directly on the printed page and slides easily over the page, without marking.

Basically, it behaves a bit like a giant mouse – you just slide it so that the lens is over the text you want to read.

Illumination is provided via four high-output white LEDs, which mount on the underside of the box adjacent to the lens. In practice, the LEDs have to be "doctored" to ensure that their light output is reasonably diffused over the camera's viewing area but this is easy to do, as described later in the article.

The end result is an easy-to-build video magnifier which you can feed into almost any old colour or B&W TV set. You should be able to build it for less than $200.

By the way this price estimate is based on using of one of the low-cost B&W cameras with a CMOS sensor that are currently available from various electronics retailers. We've tried it out using two of these: the Swann unit sold by Dick Smith Electronics as Cat. L-5877 ($89.86) and the Samsung unit sold by Jaycar Electronics as the QC-3474 ($89.95). These both give good results, although the Swann unit requires a minor modification to disable its inbuilt IR LEDs, so that it runs cooler (more on this later).

Of course, other mini CMOS cameras from other suppliers should also be suitable.

How it works

Refer now to Fig.1 for the circuit details. The output of the CMOS camera is fed through a video processing circuit that's rather similar to some of our video enhancers but modified to enhance the contrast. The circuit can also generate a negative version of the image, without degrading the signal's sync pulses.

As shown, the video output from the camera is terminated in a 100Ω load, to provide matching. It then passes through a 1µF coupling capacitor, after which it splits in three directions:

The Video Reading Aid skates over the printed page on a plastic skirt (actually an upside down food container). This keeps the lens at the correct focal distance and makes the unit easy to operate.

across to CMOS analog switch IC2a, down to the pin 2 input of sync separator chip IC4 (via a 100Ω resistor and 100nF capacitor) and further down to the non-inverting (pin 3) input of video amplifier stage IC5a.

IC4 (the sync separator) is used to extract the sync and "back porch" gating pulses from the video signal. These are then used to provide control signals for video switches IC2a and IC2b.

In greater detail, both the back porch and composite signals are combined in gate IC3c (used here as a negative-input OR gate) and used to turn on switch IC2a, to allow the sync and blanking information to pass straight through. At the same time, IC3a inverts this signal to control switch IC2b. This latter switch allows the processed video through to the output buffer (IC5b) during the "active" part of each video line.

In effect, IC2a and IC2b operate in complementary fashion. When IC2a is on (closed), IC2b is off (open) and vice versa. This means that when IC2a is closed, the sync and blanking pulses are fed through to IC5b while the active video is blocked. Conversely, when IC2b is closed, the active video is fed through and the sync signal is blocked.

The "back porch" (or burst gating) pulses from pin 5 of IC4 are also invert-

The Video Reading Aid is based on a miniature black & white CMOS camera such as this Swann unit from DSE.

ed by IC3b and used to control switch IC2c. This forms an active clamp to fix the blanking level of the incoming video to ground potential.

The part of the circuit we've just described is basically the control section, which ensures that only the active video is subjected to processing. Now let's look at the actual processing circuitry itself, which involves IC5a, IC6, transistor Q1 and IC2d.

IC5a is simply a video amplifier and operates with a fixed gain of two, as set by the two 510Ω resistors in its feedback divider. Its output at pin 1 becomes the "high contrast analog positive" video signal and is fed to the first position of selector switch S1.

This same output signal is also fed to the non-inverting input (pin 2) of

Parts List

1 PC board, code 02110051, 122.5 x 57.5mm
1 UB3 utility box, 130 x 67 x 44mm
1 mini CMOS B&W TV camera (see text)
2 L-brackets, 15 x 15 x 10mm – see text
1 47µH RF choke (RFC1)
1 3-pole rotary switch (S1)
1 2.5mm PC board mounting DC connector (CON1)
1 RCA connector, PC board mounting (CON2)
1 4-pin SIL header strip
4 M3 x 25mm tapped metal spacers
8 M3 x 6mm machine screws
2 M3 x 10mm machine screws
1 3m length of light figure-8 twin shielded cable
2 RCA plugs, yellow
1 12V/200mA regulated plug pack supply with 2.1mm plug
1 2.1mm concentric DC line socket (to match plugpack)
1 Microsafe plastic food container, 130 x 105 x 60mm (available from Woolworths)
1 1kΩ mini horizontal trimpot (VR1)
1 5kΩ mini horizontal trimpot (VR2)

Semiconductors

1 741 op amp (IC1)
1 4066B quad bilateral switch (IC2)
1 4093B quad CMOS Schmitt NAND gate (IC3)
1 LM1881 video sync separator (IC4)
1 MAX4451ESA dual video amp (IC5) (www.futurlec.com.au)
1 LM311 comparator (IC6)
1 PN100 NPN transistor (Q1)
4 5mm high-brightness white LEDs (LED1-LED4)
3 1N4148 signal diodes (D1,D2, D5)
2 1N4004 power diodes (D3,D4)
1 1N752 5.6V/400mW zener diode (ZD1)

Capacitors

1 220µF 16V RB electrolytic
1 10µF 10V RB electrolytic
3 4.7µF 16V tantalum
1 1.0µF MKT metallised polyester
2 100nF MKT metallised polyester
6 100nF multilayer monolithic
1 2.2nF 50V disc ceramic
1 220pF 50V disc ceramic
1 22pF 50V disc ceramic

Resistors (0.25W, 1%)

1 680kΩ	1 2.2kΩ
1 33kΩ	2 1kΩ
1 4.7kΩ	4 510Ω
1 3.9kΩ	4 270Ω
1 3.3kΩ	4 100Ω
1 2.7kΩ	1 75Ω

IC6, an LM311 high-speed comparator. This compares it with a reference DC voltage level on pin 6, as set by trimpot VR1, to generate a "hard limited" or rectangular digital equivalent of the boosted video signal.

IC6 has positive feedback applied via the 4.7kΩ, 100Ω and 33kΩ resistors, to give it a small amount of hysteresis and ensure clean switching. Trimpot VR2 also allows fine adjustment of this feedback. The output from pin 7 is then fed to transistor Q1, which is connected as an emitter follower to provide buffering.

From there, the buffered signal is fed to the second position of selector switch S1, to become the hard limited or "Digital Positive" video signal. This signal is also fed to the control gate (pin 12) of IC2d, used here as an analog inverter. The inverted video signal appears at pin 11 and is fed to the third position of S1, to become the "Digital Negative" video signal.

Limiting circuit

The processed video signal selected by switch S1 is first fed through a simple diode limiting circuit involving diodes D1-D3 and a 1kΩ series resistor. Diode D3 ensures that the negative excursions of the signal (ie, its black level) are clamped at 0.6V below ground, while D1 and D2 ensure that the positive excursions (ie, peak white level) are clamped at 1.2V above ground. The processed video fed to video switch IC2b is thus limited to a fairly normal voltage range, so it shouldn't cause any overload problems, either in the video output buffer stage (IC5b) or in the TV set.

The recombined sync and video signals from switches IC2a and IC2b are fed to pin 5 of IC5b via a simple low-pass filter comprising a series 100Ω resistor and 22pF capacitor. This removes any switching transients. The signals are then passed through video buffer IC5b, which operates with a fixed gain of two, to compensate for the losses in the 75Ω "back termination" resistor in series with the output. This is the standard video buffer configuration and is used to allow the output signal to be fed along relatively long video cables with minimal degradation.

Power supply

Both the mini video camera and the video processing circuitry are powered from an external 12V DC source – either a 12V battery or a regulated plugpack supply delivering 12V at up to about 150mA. The four white LEDs (LED1-LED4) used to provide illumination are powered from the same source.

Series diodes D4 and D5 provide reverse polarity protection and also reduce the overall supply voltage to 10.8V, which is necessary to protect both IC5 and the CMOS camera from over-voltage damage. Because IC5 needs a balanced bipolar supply, IC1 and ZD1 are used to give the 10.8V supply an active "centre tap", which is connected to the circuit's earth. The two main supply rails thus become +5.4V and -5.4V nominal with respect to ground.

The CMOS camera and all of the remaining ICs are connected directly between the +5.4V and -5.4V rails, as are the illumination LEDs. The latter are connected in two series strings, with a 270Ω resistor in each string to limit the current to around 17mA. Provided high-brightness white LEDs are used, this modest current provides plenty of illumination.

Construction

All of the video processing circuitry fits on a PC board measuring 122.5 x 57.5mm and coded 02110051. This board has a rounded cutout in each corner, so that it slips neatly inside a standard UB3 jiffy box. The video selector switch is located near the centre of the board, while the DC input and video output connectors at mounted at one end – see Fig.2.

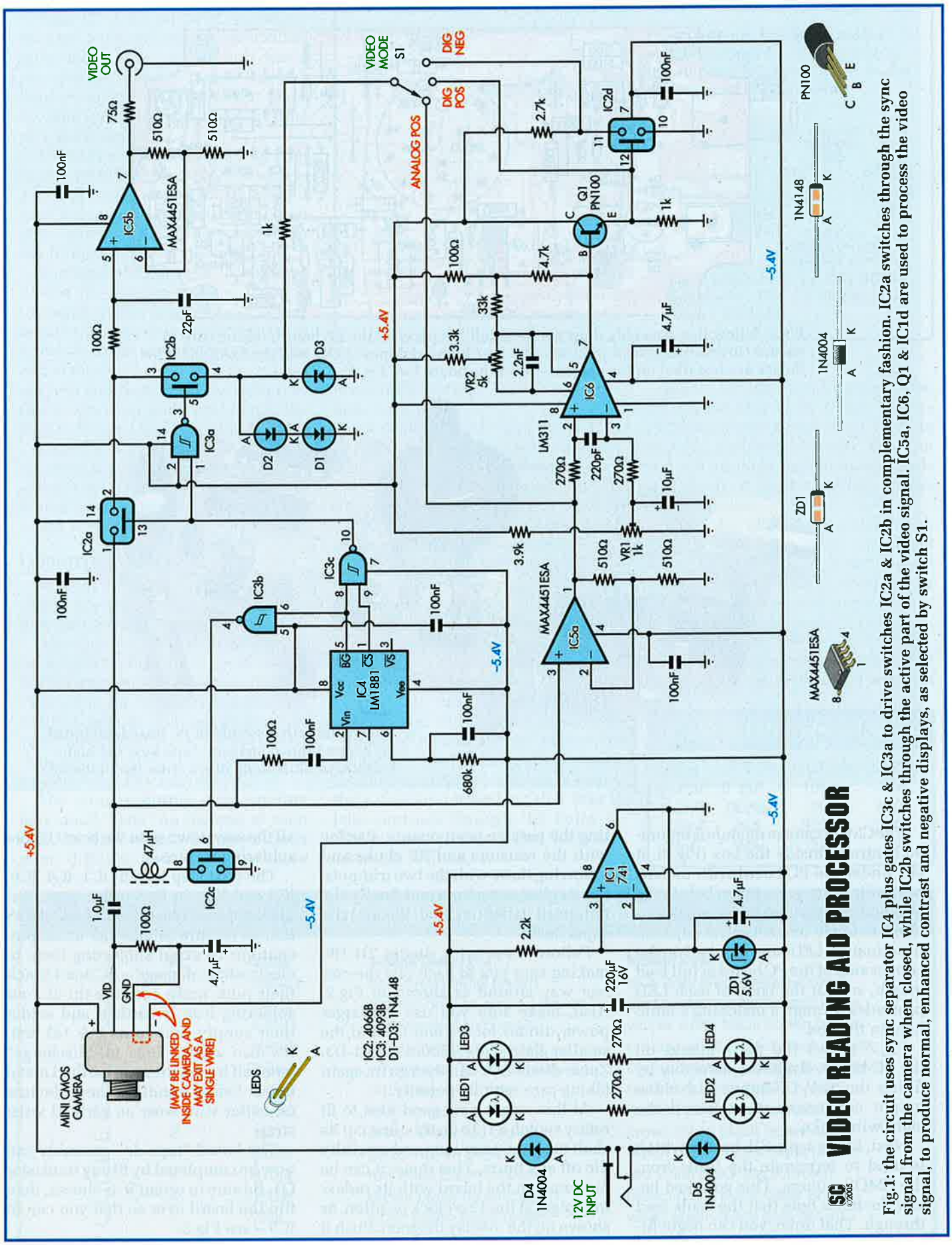


Fig.1: the circuit uses sync separator IC4 plus gates IC3c & IC3a to drive switches IC2a & IC2b in complementary fashion. IC2a switches through the sync signal from the camera when closed, while IC2b switches through the active part of the video signal. IC5a, IC6, Q1 & IC1d are used to process the video signal, to produce normal, enhanced contrast and negative displays, as selected by switch S1.

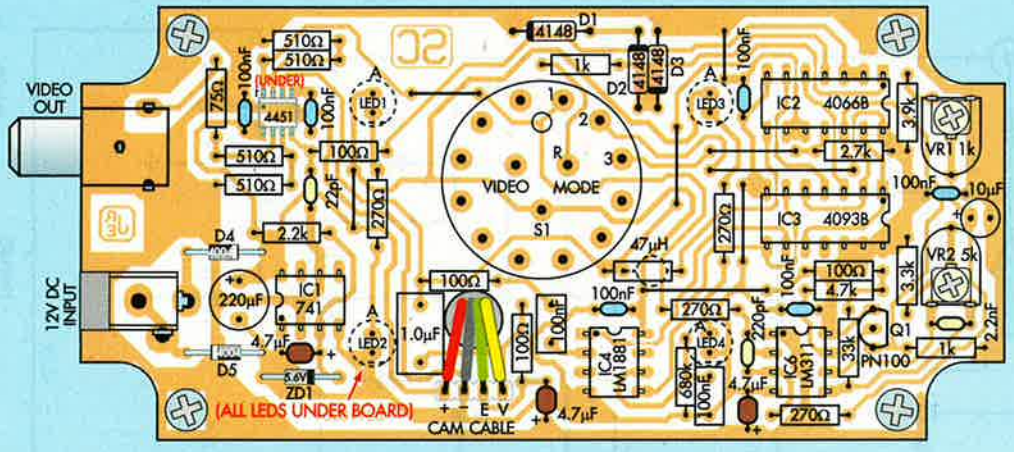
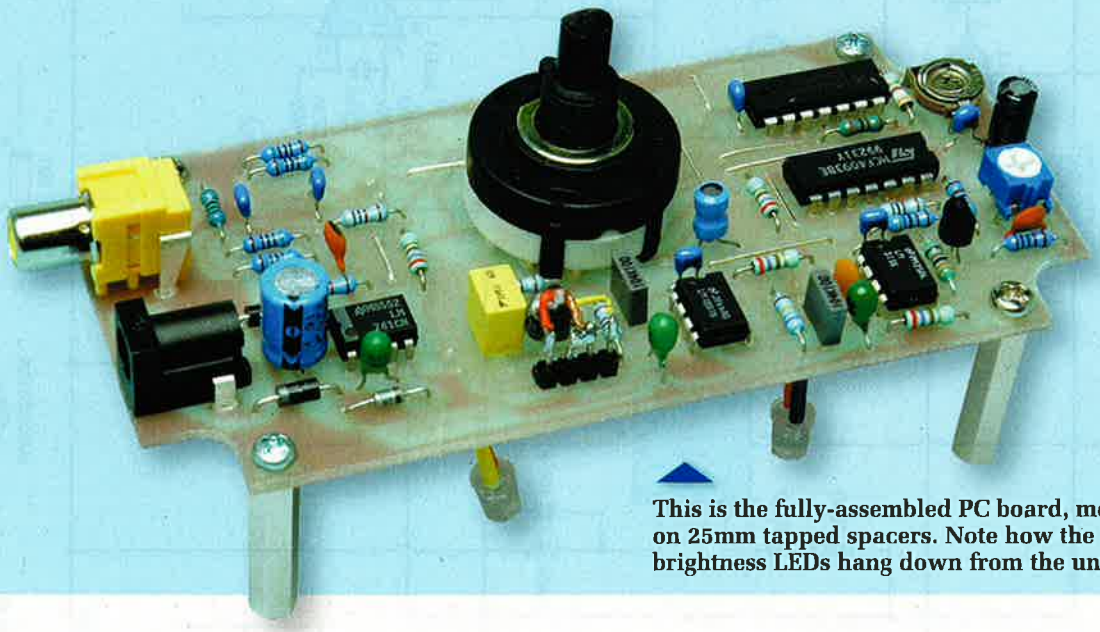


Fig.2: follow this assembly diagram to install the parts on the PC board, taking care to ensure correct component polarity. The four high-brightness LEDs and the MAX4451ESA device are installed on the copper side of the board (see Fig.3).



This is the fully-assembled PC board, mounted on 25mm tapped spacers. Note how the high-brightness LEDs hang down from the underside.

The CMOS camera module is mounted centrally inside the box (Fig.6). It sits under the PC board with its lens protruding through a 16mm hole in the base and is supported by two small aluminium angle brackets. The adjacent illumination LEDs are mounted on the copper side of the PC board at full lead length, so that the body of each LED protrudes through a matching 5.5mm hole in the box.

Fig.2 shows the parts layout on the PC board. Begin the assembly by fitting the 12V DC input and video output connectors, then install the eight wire links.

Next, fit the 4-pin SIL header which is used to terminate the leads from the CMOS camera. This goes just below the 8mm hole that the leads feed through. That done, you can begin fitting the passive components, starting with the resistors and RF choke and following these with the two trimpots, the smaller capacitors and finally the polarised tantalum and electrolytic capacitors.

Follow these with diodes D1-D5, making sure you fit each one the correct way around as shown in Fig.2. Also, make sure you use the larger power diodes for D4 and D5 and the smaller glass signal diodes for D1-D3. Zener diode ZD1 can then go in, again taking care with its polarity.

At this stage, it's a good idea to fit rotary switch S1. To do this, first cut its shaft to about 8mm long and carefully file off any burrs. That done, it can be mounted on the board with its indexing spigot at the 12 o'clock position, as shown on the overlay diagram. Push it all the way down onto the board before soldering its pins.

The next step is to fit IC1, IC4, IC6, IC3 and IC2, in that order. Note that the last two of these devices are CMOS ICs, so be sure to take the usual precautions to avoid subjecting them to electrostatic damage – ie, don't touch their pins, make sure the tip of your soldering iron is earthed and solder their supply pins (pins 7 & 14) first. It's also a good idea to "discharge" yourself by touching an earthed metal object before handling these devices or, better still, wear an earthed wrist strap.

The board "topside" assembly can now be completed by fitting transistor Q1. Be sure to orient it as shown, then flip the board over so that you can fit IC5 – see Fig.3.

This IC is in an SOIC-8 surface mount package which measures only about 5mm square and has a pin spacing of just 1.25mm. It is just large enough to be soldered in place by hand, provided you take your time and work carefully.

This job requires a soldering iron with a very fine tapered bit, which is also well tinned and clean. You should use fine gauge (ie, 0.8mm) resin-cored wire solder, to ensure there are no solder bridges between adjacent pins.

The best procedure is to hold the device in position using a wooden toothpick while you carefully solder one of its supply leads – either pin 4 or 8. This involves just touching the outer end of the device lead with the soldering iron and feeding on the solder, so that a tiny drop melts and bonds the lead to the pad underneath.

That done, you can quickly solder the other supply lead and then the rest of the leads. So the trick is to make one joint first, to hold the device in place while you solder all the other leads.

Doctoring the LEDs

Now for the LEDs. These are left until last because, as mentioned earlier, they first have to be "doctored".

As supplied, the rounded end of each LED's clear body produces a fairly narrow semi-focused axial beam. That's fine for most applications but not this one, as this would produce very uneven lighting below the camera lens, with four bright spots separated by relatively dark regions.

The cure is simple – by sanding four small "flats" on the end of each LED, its light output becomes much more diffused and this gives more even illumination. Fig.4 shows the basic idea.

It's quite easy to sand these flats by hand, because the LED bodies are moulded in a fairly soft "water clear" plastic. A small piece of medium garnet paper wrapped around a piece of flat wood will do the job quite nicely and you will only need seven or eight passes to produce each flat at the correct angle (the exact angle isn't critical, by the way).

Don't try to polish the surfaces after sanding – just leave them with the after-sanding matt finish, as this gives better light diffusion.

After all four LEDs have been treated, you can fit them to the underside of the board. They must all be mounted at full lead length (ie, with the shorter cathode leads just entering their matching holes), so that they'll later protrude through the holes in the bottom of the box when the board assembly is fitted.

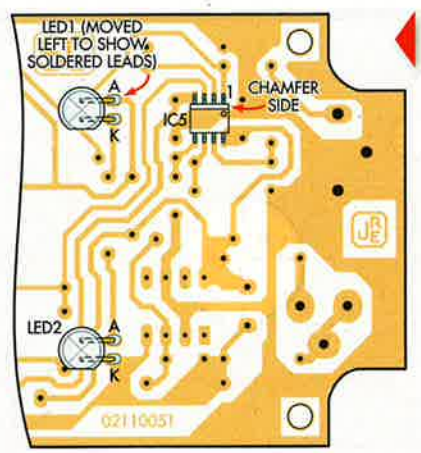


Fig.3 (left): use fine-gauge solder and a fine-tipped soldering iron to install the SOIC device (IC5) on the underside of the PC board.

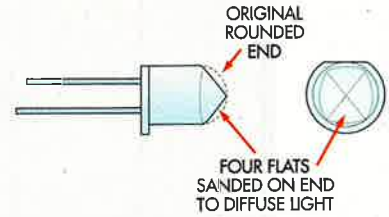


Fig.4: here's how the four high-brightness LEDs are modified to diffuse the light.

Before actually installing the LEDs, it's a good idea to fit 20mm lengths of 2mm sleeving over each lead, to prevent accidental shorts. You can use red sleeving for the anode leads and green or black sleeving for the cathode leads.

After the LEDs have been fitted, the board assembly can be completed by attaching four M3 x 25mm tapped spacers (one at each corner), using 6mm long M3 machine screws.

Box preparation

The box needs to have a number of holes cut in the bottom and lefthand

Table 2: Capacitor Codes

Value	µF Code	IEC Code	EIA Code
100nF	0.1µF	100n	104
2.2nF	.0022µF	2n2	222
220pF	NA	220p	220
22pF	NA	22p	22

Table 1: Resistor Colour Codes

❑	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	1	680kΩ	blue grey yellow brown	blue grey black orange brown
❑	1	33kΩ	orange orange orange brown	orange orange black red brown
❑	1	4.7kΩ	yellow violet red brown	yellow violet black brown brown
❑	1	3.9kΩ	orange white red brown	orange white black brown brown
❑	1	3.3kΩ	orange orange red brown	orange orange black brown brown
❑	1	2.7kΩ	red violet red brown	red violet black brown brown
❑	1	2.2kΩ	red red red brown	red red black brown brown
❑	2	1kΩ	brown black red brown	brown black black brown brown
❑	4	510Ω	green brown brown brown	green brown black black brown
❑	4	270Ω	red violet brown brown	red violet black black brown
❑	4	100Ω	brown black brown brown	brown black black black brown
❑	1	75Ω	violet green black brown	violet green black gold brown

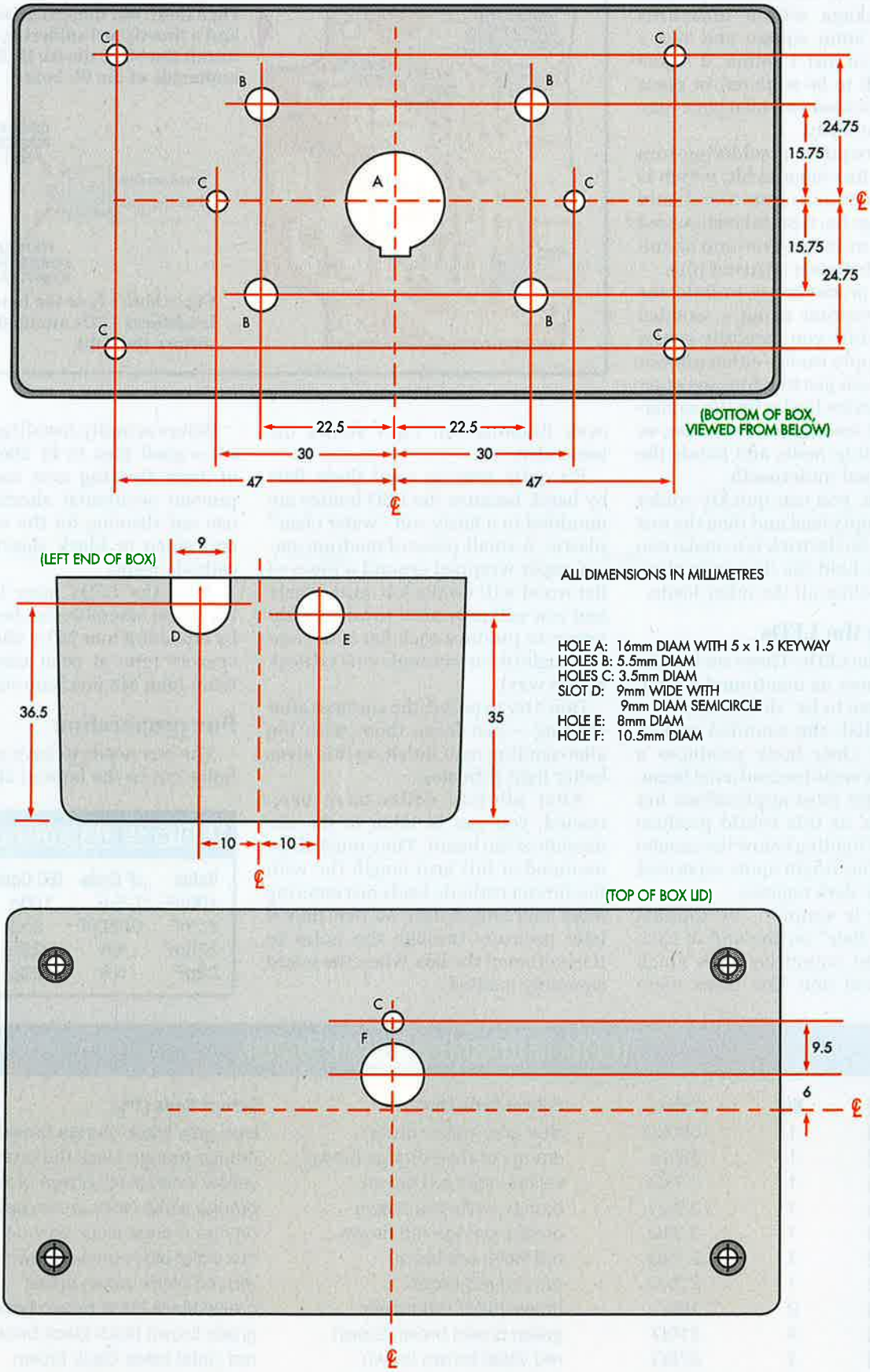


Fig.5: here are the drilling details for the plastic case. It's best to make the larger holes by drilling small-diameter holes first and then carefully enlarging them to size using a tapered reamer.

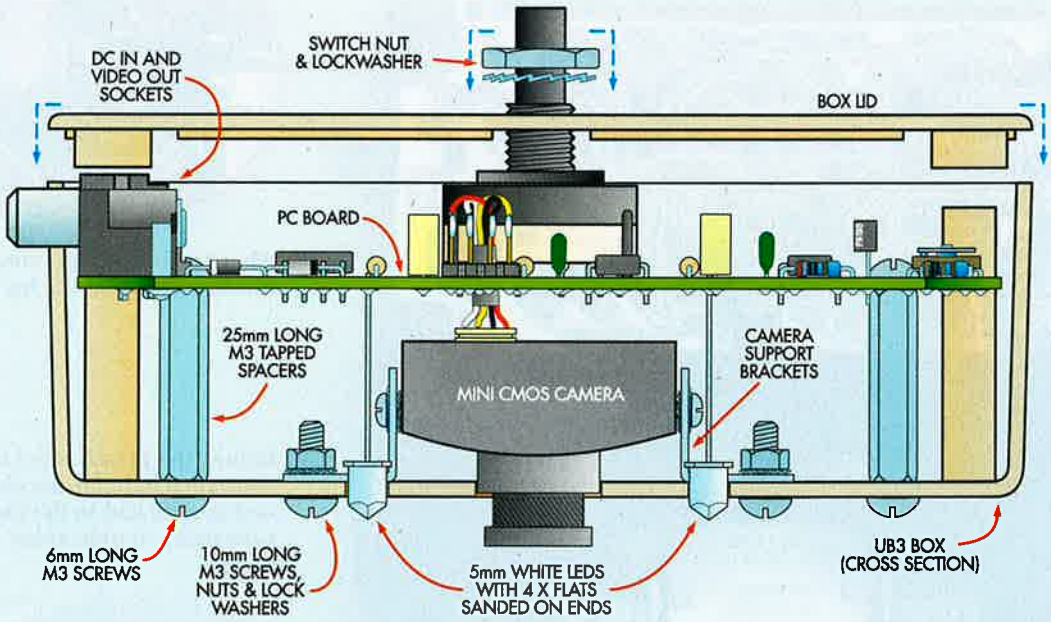

DC IN AND VIDEO OUT SOCKETS
SWITCH NUT & LOCKWASHER
BOX LID
PC BOARD
25mm LONG M3 TAPPED SPACERS
MINI CMOS CAMERA
CAMERA SUPPORT BRACKETS
6mm LONG M3 SCREWS
10mm LONG M3 SCREWS, NUTS & LOCK WASHERS
5mm WHITE LEDS WITH 4 X FLATS SANDED ON ENDS
UB3 BOX (CROSS SECTION)

Fig.6: this diagram shows how it all fits inside the case. Note that the lid should sit firmly on the switch indexing ring, to keep it in place when everything is screwed down.

end of the base, plus two holes in the lid. The positions and sizes of these holes are shown in Fig.5.

Depending on the box, you may also have to cut away some of the plastic ribs moulded on the inside at one end, near the input/output connectors. This can be done using a sharp chisel.

Mounting the camera

Once you've drilled all the holes, the mini camera can be prepared for mounting. First, remove the two screws which attach it to its existing U-bracket, then cut the camera's output cable about 40mm from the body (or its mini connection plug). Remove about 15mm of the outer sleeving from the end, then separate the individual leads. In most cases, the positive power lead has red insulation, while the video lead has yellow insulation. The negative power lead usually either has black insulation or is in the form of a screening ground braid.

If the camera also has an audio output (many of them do), this is usually a wire with white insulation. This output isn't used in this project, however.

After separating the various leads, strip about 5mm of insulation from the ends and tin the exposed wire ends, ready for connection to the 4-way header on the PC board. If you camera has a ground braid, this should be neatly twisted together, sleeved and tinned as well.

And that's basically all you have to do to prepare a camera like the Samsung unit sold by Jaycar. However, with a camera like the Swann unit sold by DSE, you also have to disable the inbuilt IR LEDs (originally intended for night illumination). That's done by removing the back of the case (it's usually attached by two tiny screws) and removing one of the LEDs – either by cutting its leads with side-cutters or desoldering them from the internal PC board.

You don't have to worry about the others, because they're usually connected in a series string.

The camera can now be mounted inside the box using two small L-brackets, made from 1mm aluminium sheet – see Figs.6 & 7. The camera mounts between the brackets using the same two screws which held it in its original U bracket.

It's a good idea to fit an M2.5 flat washer on each screw before passing it through the hole in the L-bracket and then fit an M2.5 star lockwasher on each screw before it enters its tapped hole in the side of the camera. This arrangement keeps the camera firmly vertical when both screws are tightened.

The camera mounting brackets are then attached to the box using M3 x 10mm machine screws, nuts and lockwashers.

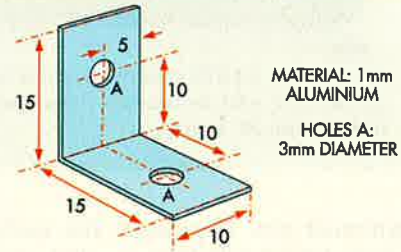
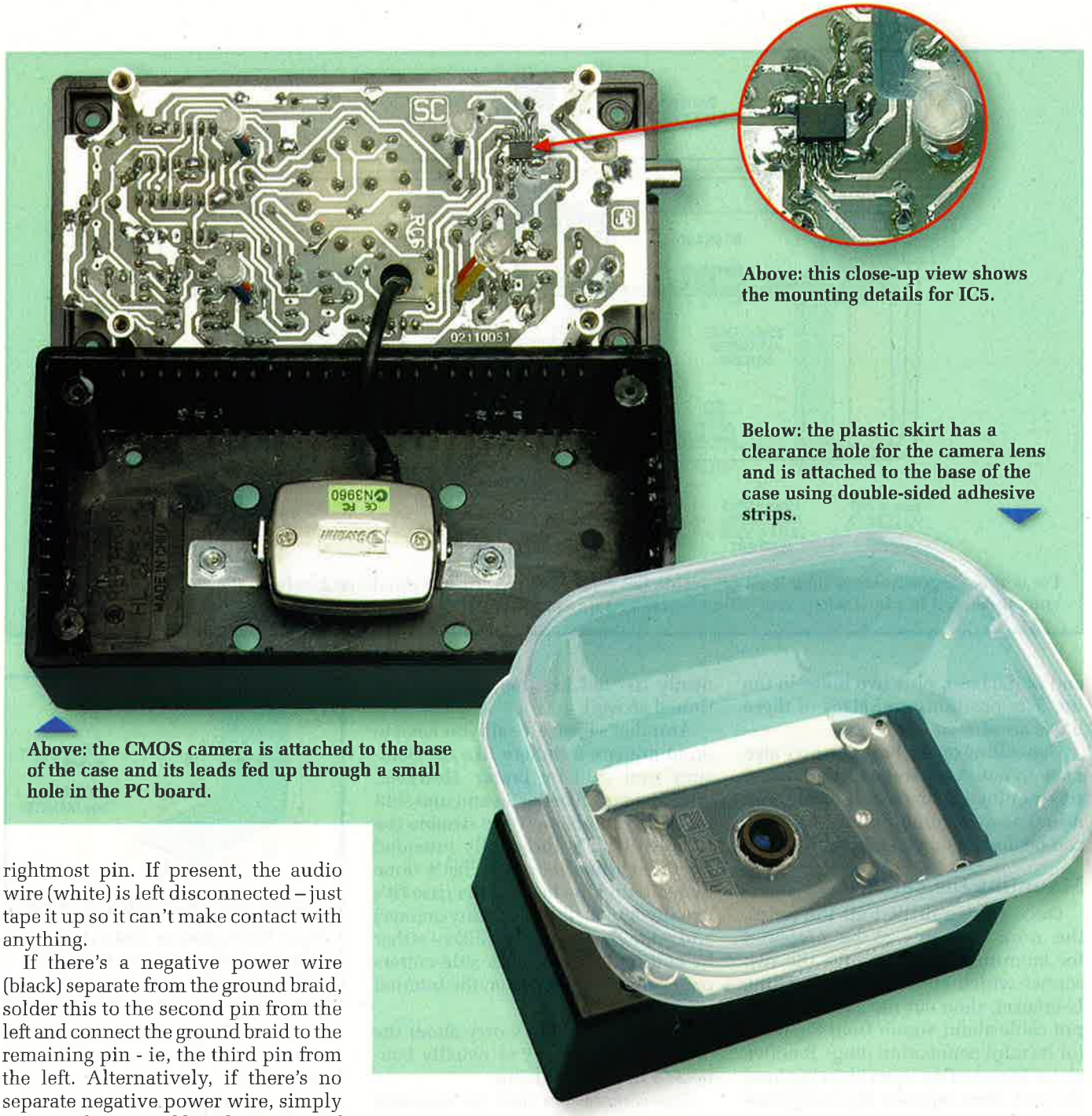


Fig.7: here's how to make the two L-brackets that support the mini CMOS camera.

Final assembly

Once the camera is mounted, the PC board (with its mounting spacers) can be lowered into position. Feed the camera cable through its board access hole as you go and make sure the four LEDs all pass through their respective holes in the base. The board assembly can then be secured from underneath using M3 x 6mm screws into the tapped spacers.

Finally, connect the camera cable leads to their respective header pins on the PC board. The positive power lead (red) connects to the leftmost pin, nearest the 1µF MKT capacitor, while the video wire (yellow) connects to the



Above: this close-up view shows the mounting details for IC5.

Below: the plastic skirt has a clearance hole for the camera lens and is attached to the base of the case using double-sided adhesive strips.

Above: the CMOS camera is attached to the base of the case and its leads fed up through a small hole in the PC board.

rightmost pin. If present, the audio wire (white) is left disconnected – just tape it up so it can't make contact with anything.

If there's a negative power wire (black) separate from the ground braid, solder this to the second pin from the left and connect the ground braid to the remaining pin - ie, the third pin from the left. Alternatively, if there's no separate negative power wire, simply connect the ground braid to BOTH of the centre pins.

The only other possibility is that your camera may have just a black negative wire and no ground braid. In this case, connect the black wire to both centre pins instead.

Switch indexing

Before testing the Video Reading Aid, you have to set the rotary switch so that it has only three positions and not four.

To check this, fit its knob temporarily to the spindle and try turning it to see how many positions are available. If there's only three, you can relax. But if there are four, the switch will need to be reset.

To do this, first turn the switch anticlockwise to its end position and then remove the knob. That done, unscrew the mounting nut, and remove both it and the star lockwasher underneath. This will reveal the indexing stop washer, which you then have to prise up using a small screwdriver. The underside of this washer has a small spigot, which sits in one of the matching slots in the switch body.

If you look closely you'll see that there are a series of numbers moulded into the switch body, between the slots. The idea is to find the slot between the numbers "3" and "4" and refit the indexing washer with its spigot in that slot. Check that the switch now has only three positions, then refit the star lockwasher and nut.

Fitting the plastic skirt

The plastic skirt fitted to the unit is actually an upside-down food container. The recommended unit (see Parts List) measures 130 x 105 x 60mm deep and has an indent in the centre of its base which provides clearance for the LEDs. The unit is also curved towards the sides, which means that it

naturally clears the four corner mounting screws that go into the spacers.

Attaching it is hardly rocket science – just cut a hole in the centre to clear the camera lens, attach some double-sided tape to its base and attach it to the bottom of the box.

If you use a different food container from the one we used, then you may have to also drill holes to clear the LEDs and the mounting screws.

Testing

Now for the smoke test! First, set the rotary switch to fully anticlockwise (Medium Contrast), set trimpot VR1 to fully anticlockwise and set VR2 to its mid-range position. That done, connect the Reading Aid's video output cable to the video input of a TV set and apply power.

Note: you must use a 12V regulated plugpack or 12V battery. Do not use an unregulated plugpack, otherwise you'll damage the camera and IC5.

If all is well, you should see a bluish-white glow from the illumination LEDs underneath the Reading Aid box. Now place the unit on some printed material. The image will probably be quite blurry initially – just adjust the lens until you get the correct focus by rotating it clockwise or anticlockwise. This will have to be done by trial and error, since the plastic skirt is in the way when the unit is resting on a surface but it shouldn't take long to get it just right.

You may also have to adjust the brightness and contrast controls on the TV to get a good image.

If there's no image or none of the LEDs is alight, you've probably got the power supply the wrong way around. No damage will result from this – just reverse the connections and all should be OK. However, if the image does appear but only two of the LEDs are alight, the odds are that you've connected at least one of the dark LEDs around the wrong way.

If all LEDs are alight and you have a clear image on the TV, turn the rotary switch to its centre position. The image will probably go very dark but if you turn trimpot VR1 slowly clockwise with a small screwdriver, it should gradually turn into a very "contrasty" but still clear black-and-white image. The correct setting for VR1 will be quite obvious – just set it for maximum clarity and best contrast.

If you can't achieve this by adjusting VR1 alone, you may also need to adjust VR2 slightly one way or the other.

Once the correct settings have been found, try switching S1 to the third position (fully clockwise). The image should change into a high contrast negative, with black type on a white background turning into white type on a black background, which many people with visual impairment find easier to read.

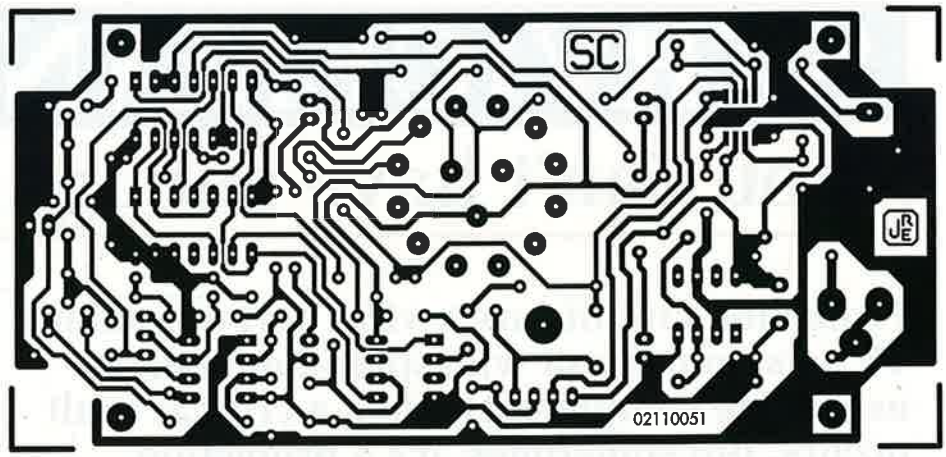


Fig.8: check your PC board for defects by comparing it with this full-size etching pattern before installing any of the parts.

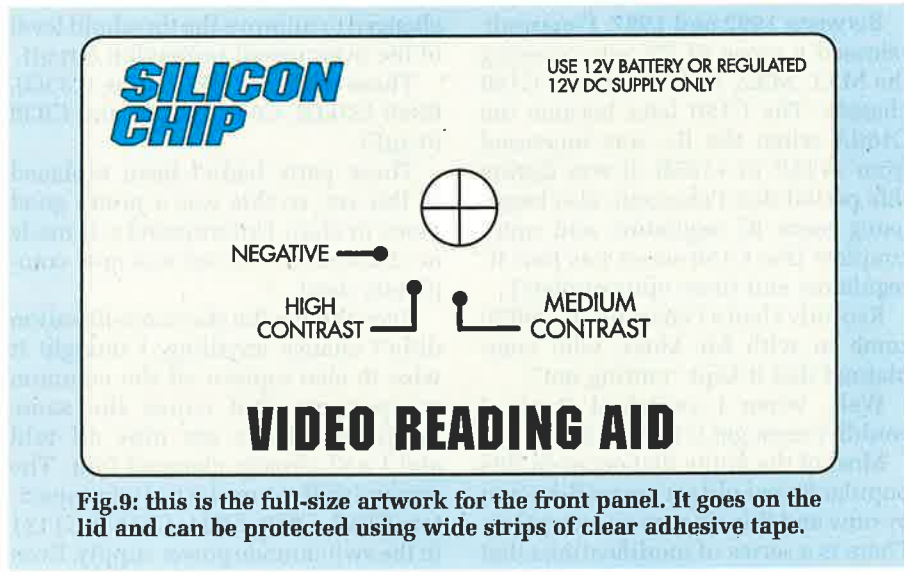


Fig.9: this is the full-size artwork for the front panel. It goes on the lid and can be protected using wide strips of clear adhesive tape.

Final assembly

Assuming it all checks out, disconnect the power supply and remove the knob, mounting nut and star lockwasher from the rotary switch. The box lid can then be slipped into position over the switch shaft and should rest on the top of the box, with the switch locating spigot passing up through the small hole that's located just behind the main spindle hole – see Fig.5.

Image Washed Out?

Depending on the high-brightness LEDs supplied and/or the amount of ambient light at the reading location, you might find that the on-screen image is washed out (ie, over-bright).

In that case, try throttling back the LED brightness by increasing their series 270Ω resistors to around 680Ω. Alternatively, if you have plenty of ambient light, you may get a better result if the LEDs are taped over (or the unit modified so that they can be switched out of circuit).

Be prepared to experiment to get a good picture if necessary.

All that remains now is to fit the four lid fastening screws and then refit the star lockwasher and nut to the switch ferrule. Your Video Reading Aid should is now ready for use. **SC**

SERVICEMAN'S LOG

You can't have enough protection

Protection circuits are a vital part of modern TV sets, to prevent widespread damage to expensive components when a critical fault occurs. But sometimes, it's a protection circuit itself that causes problems.

Items Covered This Month

- Panasonic TC29R20 TV set (C150A chassis)
- Teac Televideo MV4822 (CP-420 chassis)
- LG PF60A3Q rear-projection TV set (MP87A chassis)
- Philips 46PP8621/79 rear projection TV set (DPTV325AA chassis).
- Sony KD32DX40AX FD Trinitron TV set (FE-2, SCC-U78A – A chassis)

Between 1992 and 1997, Panasonic released a range of TV sets covering the MX1, MX2, MX3, M16 and C150 chasses. The C150 later became the C150A when the B+ was increased from +115V to +125B. It was during this period that Panasonic also began using more IC regulators and optocouplers (the C150 series has four IC regulators and three optocouplers).

Recently I had a Panasonic TC29R20 come in with Mr Moss, who complained that it kept "cutting out".

Well, when I switched it on, I couldn't even get it to "cut in".

Most of the faults that occur in this popular 9-year old set are well-known by now and this set was no exception. There is a series of modifications that are designed specifically to fix these particular symptoms (intermittent shutdown), which were released on 11th July, 1997 by Panasonic Technical Information. In particular, two resistors and two capacitors have been changed to improve the threshold level of the overcurrent protection circuit.

These parts are R835 (now 0.33Ω), R848 (33kΩ), C831 (3.3µF) and C838 (0.1µF).

These parts hadn't been replaced in this set, so this was a pretty good place to start. Unfortunately, it made no difference – the set was now completely dead.

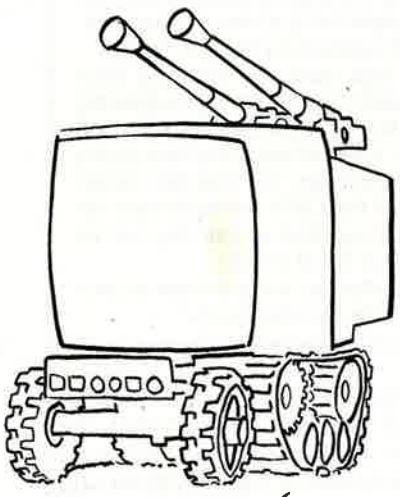
Even though the above modification didn't change anything, I thought it wise to also replace all the common components that cause the same symptoms. There are nine all told and I had already changed four. The remaining five are electrolytic capacitors C817, C820, C824, C455 & C1121 in the switchmode power supply. Even in the event that this didn't fix the fault, I couldn't send this set back to Mr Moss with a warranty when these components are known to fail.

Besides, they don't take very long to replace.

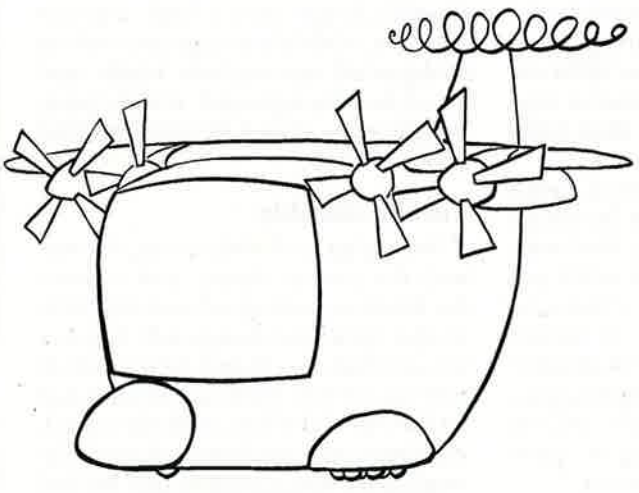
Anyway, this didn't fix the fault but it did change the symptoms slightly. The set would now occasionally come on for a few minutes (with perfect picture and sound) and then cut out.

When the set is on, the red LED is on, being fed by the 5V rail from C1106, which is in turn fed by 16V from D812 and Q802. This rail drops to 9V in the Standby mode. The three optocouplers between the primary and the secondary are for voltage control feedback and standby switching (D803) and to provide protection (D811 and D836).

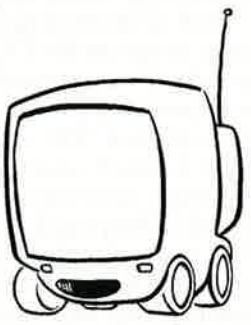
In this case, I was beginning to suspect that it was the protection circuits



PANASONIC M16



PANASONIC C150



PANASONIC MX3

that were closing the set down. When the set came on, I managed to check that the main power rail at TPE1 was +125V but couldn't confirm that the set subsequently switched off because it might have intermittently gone high. However, I did confirm that there was +325V coming out of the main bridge rectifier (D806) – ie, across C809.

It was time to disable the protection circuitry step-by-step until the set stayed on. This can be a bit dodgy if there is a real fault on that line, because it will now have the opportunity to really destroy other parts without hindrance.

The entire protection circuit can be switched off by disconnecting D823 on the primary hot side which feeds Q827. This told me that the set itself was OK, because the picture and sound were rock steady and there was no sign of any strain. This meant that it was highly likely that the protection circuits themselves were faulty.

Next, I resoldered D823, then moved to the cold side of the supply and shorted Q805's base to ground (emitter). This too allowed the set to switch on and function reliably.

One of the most common faults in this set is dry joints on the vertical output IC (IC451, LA7838). If this fault is allowed to fester, it will eventually destroy the IC and cause too much current to be drawn from the 24V rail. This is detected by Q454 which in turn switches on Q805. However, this wasn't the case with Mr Moss's set.

Gradually, I disabled each of the protection feeder circuits until at last I found that disconnecting D832 allowed the set to function. This was surprising, as I had already replaced C831 and R835 in this main B+

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THERE WAS A LARGE AIR BUBBLE, RESULTING IN OVERHEATING...

current protection circuit, making it less sensitive. Basically, this circuit includes Q831 which is switched on if the voltage across R835, the main HT feed resistor, rises too far, due to excess current. This in turn switches transistor Q805 on via D832.

In all, a total of seven components are involved in this circuit and they all tested OK in-circuit. Replacing Q831 (2SA1018) finally fixed the fault, although the original tested perfectly after removal (I_C = 0mA, I_B = 4.56mA, h_{fe} = 91, I_r = 2.5mA, V_{BE} = 0.73 and no collector emitter leakage).

I wasn't that surprised because leakage can often develop between the leads of a transistor due to dirt and corrosion – especially if the set lives near the beaches. Just by moving the leads slightly (eg, when removing the transistor) can cause this corrosion to "flake off", restoring it to working order. That said, it's quicker, cheaper and more reliable just to replace it.

Teac Televideo

Mrs Austin brought in a smart silver little 1999 Teac Televideo MV4822 (CP-420 chassis). The problem was a tape jammed inside and a relay that was chattering on and off continuously.

Unfortunately, I had no circuit for this model but being adventurous, decided to go in blind. I started with a careful examination of the whole set, beginning at the power supply, looking for "hot spots", marks or stains on the PC board and on components that might have been under stress.

Luckily, the voltages were actually marked on the printed circuit board (bless the Teac designers; if only other manufacturers would do this more often). The main power supply itself seemed OK but although the EVER 6V rail was correct, the EVER 8V rail was down to only 5.5V. The 6V rail is usually for the microprocessor and digital circuits, while the 8V rail fed the remote control relay solenoid.

This 8V rail is supplied by a separate switchmode standby power supply and ICI807 (TOP210) was running hot, its legs turning brown. Before ordering a new one, I noticed a small 47µF 25V electrolytic (C840) in its control circuitry and decided to replace it – just in case.

Well, Mrs Austin and I were both lucky as this was the cause of the problem. After replacing it, the set came on and ejected the tape correctly. And the relay stopped chattering.

The rear-projection LG

Mr and Mrs Paterson have a massive 60-inch ((150cm) LG rear projection TV (model PF60A3Q, MP87A chassis). Its problem was that the picture was flashing black and white and the sound was giving a knocking noise intermittently.

Well, the set was so big that it wouldn't fit into our Toyota Hi-Ace for transport back to the workshop. As a result, I removed the top screen assembly so that at least we could take out the base assembly.

Back on the bench, I fixed up a temporary screen just below the ceiling using a large sheet of cardboard. At least, this would allow me to monitor what was a very intermittent problem.

I started by checking the supply rails and then the deflection outputs but everything was rock steady. Gradually, my attention moved to the small signal board which also has the twin tuners, IF stage and Picture-in-Picture circuitry, plus the AV interface boards. I tried heating, freezing and vibrating these circuits but derived no new clues.

LG were helpful and suggested replacing crystal XT75 but this too made no difference. Finally, despite its cost of $500, in the end an "executive decision" was made to replace the whole panel.

Well, the new one was fitted and the picture was now consistently perfect but there was no sound at all!

After a lot of crawling around on the floor on my hands and knees, an audio amplifier probe finally revealed a problem with the relay RL601. It had poor contacts, so I replaced it with one from an old board.

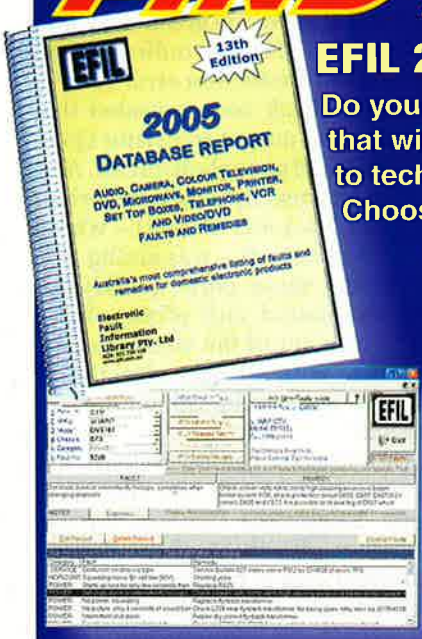
Finally, the set was loaded back into the van and reassembled back at the Patersons. After reassembly, it all worked properly. Thank goodness.

Fixing Philips

One of the most common faults in projection TVs is the failure of the convergence output ICs.

Recently, we had a Philips 2002 46PP8621/79 using a DPTV325AA

FIND FAULTS FAST!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Australia's most comprehensive listing of faults and remedies for domestic electronic products
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chassis. Both the STK392-120 ICs (ie, 7044 and 7045) on the C4 small-signal module were short circuit and the reason wasn't obvious until you examined the IC heatsink. Insufficient silicone heat transfer compound had been applied in the factory and on both ICs, there was a large air bubble, resulting in overheating due to poor heat transference.

Applying an even layer of thermal compound over the entire area of the new IC fixed the problem completely.

The mystery fault

I encountered a mystery this week, for which I have no answer.

I was called out to Mrs Downie's Sony 1997 KV-G2152 (BG-2S chassis), which had no sound. Normally, these are pretty straightforward to fix and the cause is fairly obvious, like the earphone socket has become dry jointed or the headphone lead is frayed.

In this case, I found that capacitor C253 (100µF 16V) which hangs off the 11V rail on the cathode of D251 and the emitter of Q202, had exploded – literally.

Mrs Downie said she was watching the TV when the sound suddenly died. She claimed she heard no bang or any other loud noise.

IC203 (TA8248K), the sound output IC, was also dead and replacing both these components fixed the problem completely.

But why, or rather how, did this fault come about? There were no other problems I could find with the set and you would expect something like a power surge to cause this violent fault to occur but apparently there was none – it happened on a normal sunny day for no reason. Explain that.

The big Sony

Mr Mosely insisted we collect his heavy 2002 Sony KD32DX40AX FD Trinitron TV (FE-2 SCC-U78A – A chassis) when I said we would be unable to fix it in his home.

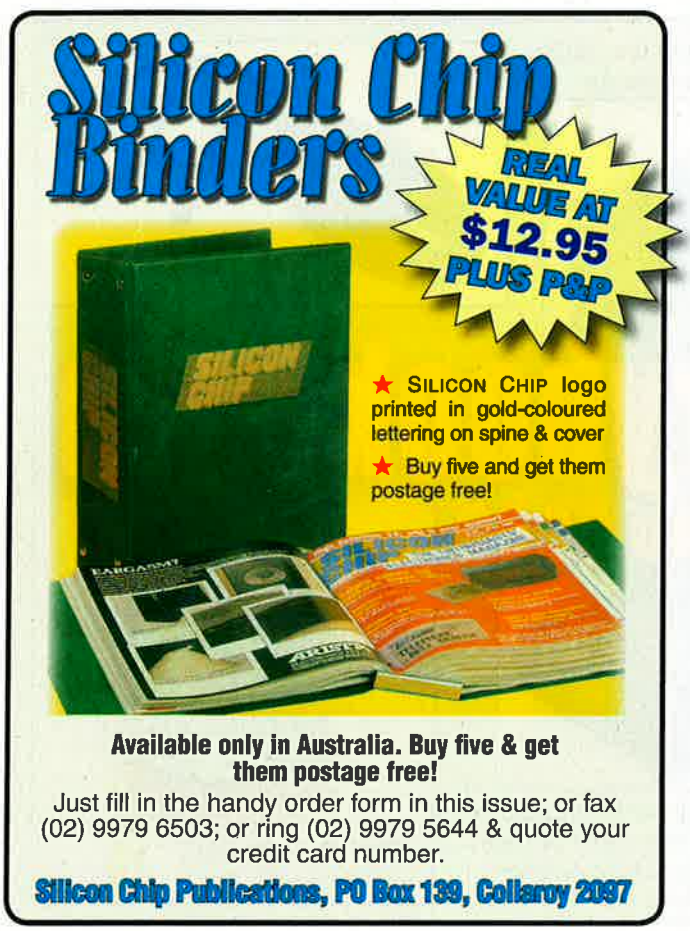
When we picked it up, he said that it had gone off while he was watching it and now only the standby light flashed. When I got it on the bench, I found that it gave one green flash and then two red flashes, indicating an Over Current Protection error (OCP).

A quick check soon revealed that the horizontal output transistor Q533 BU2515DX had gone short circuit. And that was because flyback transformer T511 (Part No.1-453-308-41) – which was the real culprit – was arcing.

Replacing these parts quickly restored the sound and picture but I wasn't quite out of the woods yet – a 4:3 picture with a bright object on it produced noticeable "blooming" of the raster.

It didn't take a genius to figure out there was problem in the ABL (Automatic Brightness Limiter) circuit. This comes off pin 11 of the flyback transformer and is held down by two resistors to ground – R518 6.8kΩ and R510 470kΩ. The former had lost a little chunk out of its body where the grey band should have been and was open circuit.

Replacing it finished the repair properly. Now the difficult bit – getting it back to Mr Mosely. **SC**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Livewire
State-of-the-art software for designing and simulating electronic circuits.
Home edition only $115 inc. postage.
PCB Wizard 3
Highly innovative PCB designer for creating single and double-sided boards.
Home edition only $115 inc. postage.
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Spring into Jaycar Electronics

October 2005

Call into one of our stores, order online or get hold of our catalogue.

Touch Screen TFT

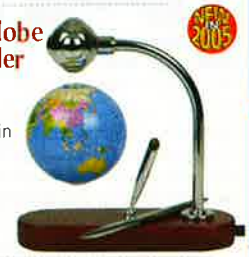
Bursting with value.
This 7" 12V monitor has superb picture resolution & exceptional audio clarity. Featuring touch screen capabilities, which enables use with laptops/PCs or other VGA operated peripherals with USB interface. For those who want to complete their in car entertainment system with a top of the line viewing device.

NEW IN 2005

Cat. QM-3749 $549.00

Suspended World Globe with Pen & Pen Holder

A fascinating gift.
The electromagnetic levitating globe floats in thin air and seems to defy the laws of gravity.



NEW IN 2005

Cat. GG-2170 $49.95

Remote Control Sailing Ship

This well constructed 1:420 scale R.C model of the 19th century 'Cutty Sark' is a must for collectors and boating enthusiast. Marvel at the intricate detail right down to the life rafts. With a five metre remote control range and efficient use of battery power, this product will guarantee hours of fun for the whole family.
•Size: 205 x 125mm

NEW IN 2005

Cat. GT-3415 $39.95

Choke A Chook

Relieve stress with a bit of violence! This annoying chicken dances around and squawks. Funny for about one second! Grab him by the throat and he screams and gags. Funny forever! (not recommended for children)
•Approx 300mm tall.
•Requires 4 x AA batteries (not incl)

NEW IN 2005

Cat. GT-3095 $29.95

2.4GHz Wireless Colour LCD Receiver

This portable monitor is ideal for keeping an eye on a sleeping baby or kids in the back yard pool. Also useful for small office & commercial locations. Accepts up to four cameras. Battery operated.
•65mm colour screen
•Audio & video output
•Battery or mains power

Cat. QC-3596 $299.00

NEW STORE OPEN IN SUNSHINE VICTORIA

NOW OPEN
204 McIntyre Road
Sunshine Vic 3020
Ph (03) 9310 8066

"Clock Watchers" Clock Kit Now with Blue LEDs

NEW IN 2005

This clock is hypnotic!

EXCLUSIVE TO JAYCAR

Ref: SC June 2005. It consists of an AVR driven clock circuit, and also produces a dazzling display with the 60 blue LEDs around the perimeter. It looks amazing, but can't properly be explained here. We have filmed it in action so you can see for yourself on our website, so check it out! Kit supplied with double sided silkscreened plated through hole PCB, and all board components as well as the special clock housing.

NOW AVAILABLE WITH BLUE LEDS

Cat. KC-5416 $189.95

NEW STORE AT BLACKTOWN NSW

178 Sunnyholt Rd
Blacktown
Phone: 02 9678 9669

OPEN 7 DAYS

Sea Scooter Check this out!!!

Here's a great water scooter that's been designed specifically for family fun in the pool, lake or protected beaches. The powerful motor can reach a maximum speed of 3km/h and is powered by a rechargeable battery which gives around 40 - 60 mins running time. It's lightweight enough to carry with one hand and portability is guaranteed by the included sports carry bag - perfect for the kids to take on your next riverside picnic. It's easy to manoeuver and control with comfortable grip handlebars and can even be used for shallow snorkelling.
•Powered by 12V 7AH battery (included)
•Up to 1 hour's intermittent use time or 40 min continuous •Thrust: 5kgf

Cat. GG-2350 $249.00

Wind Powered Generator Experimenters Kit

A great learning tool!
This small scale project enables you to build a real working wind generator, and then use it for experimenting. It can supply up to 10VDC @ 100mA (depending on wind speed), and features an on-board 330uF capacitor so you can store the energy for later use. Kit includes all parts to make the generator, fan assembly, and pedestal. Stands 250mm high.

Cat. KJ-6696 $49.95

5" B&W Surveillance System

Quick and simple! Consisting of a 5" B&W surveillance monitor, two cameras, and two dummy cameras. The real cameras simply plug in with their 10m lead, and the dummy cameras look identical. Great for small shops.

Cat. QC-3446 $149.00

2.4GHz Wireless Security Camera Kit

Simple Surveillance! Covert surveillance is now possible with the use of this 2.4 GHz transmitter /receiver package. Monitor remote locations up to around 100m with video and audio capture. Keep an eye on the front of your home, office or shop from out the back without the hassle of installing cables. The camera and receiver can be mains powered with the plugpacks provided. The receiver has composite video RCA output to go to the monitor and or recording device. Extra cameras available. Cat. QC-3581 $129.00

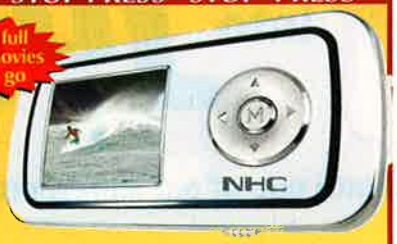
Cat. QC-3580 $199.00

COMPUTER & AV

STOP PRESS STOP PRESS STOP PRESS STOP PRESS STOP PRESS

Watch Movies, Listen to Your Favourite Songs on this 1GB MP4/MP3 Player

Watch full length movies on the go



Check this out!
This blows conventional MP3 players and solid state flash disks out of the water! This unit is feature packed, just check out the line-up!
- MP3 player of course - 1GB storage for a few hundred songs!
- JPEG picture viewer - run slideshows for you and your friends
- Built-in FM radio
- Voice recorder - take voice notes or record conversations (with permission of course)
- MPEG-4 player - so you can watch full length movies on the go!

It measures just 75 x 37 x 14mm, and weighs less than 40g! The 1.3" high resolution TFT LCD screen provides crystal clear pictures, and is the perfect way to keep yourself entertained. See our website for full details. **Was $399**

NEW IN 2005

NOW AVAILABLE

SAVE $50

Cat. GE-4006 $349.00

STOP PRESS STOP PRESS STOP PRESS STOP PRESS STOP PRESS

128MB MP3 Player with LCD Screen

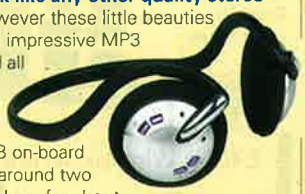
Great music portability.
It can store up to two hours of MP3 music or four hours of WMA music. It has 5 inbuilt equalisation settings for optimum sound and can operate just as a USB flash disk. **Was $149**

SAVE $70

Cat. GE-4001 $79.00

MP3 Player Back-Phones

These might look like any other quality stereo back-phones, however these little beauties actually include an impressive MP3 player, battery and all the controls you need to listen to your favourite music. The 128MB on-board memory will hold around two hours of music and run for about 15 hours on one charge of the internal battery.



Cat. GE-4002 $99.00

Pedometer with 128MB MP3 Player

NEW IN 2005

Time flies when you're exercising!
Built in MP3 player stores up to two hours of music. Includes calorie counting, distance monitor as well as a clock. Supplied with USB interface cables & earphones. Size: 68(L) x 39(W) x 22.5(H)mm. **Was $119.95**

SAVE $20

Cat. GE-4012 $99.95

Wireless MP3 Modulator For In-Car Use

Use your USB flash drive and this clever device to play your favourite MP3 files in the car.
The unit is the size of a normal car cigarette lighter plug and is fitted with a USB socket. The combination allows you to play your MP3 files by transmitting them to your car's FM radio. You can also use the device to listen to an ordinary portable CD, DVD or MP3 player,or any other audio sources.

Cat. GE-4030 $69.95

Portable iPod / MP3 Player Dock and Speakers

Featuring 1.5" micro speakers, & an internal amplifier, they sound great. It all folds up to a neat 286g package when not in use. Powered by 4 x AAA batteries not included.
- iPod not included.

Cat. XC-5163 $89.95

iPod Car Charger

Charge on the go!
Connects to your car's cigarette lighter socket to charge your iPod via the Apple 30 pin connector. Great for travellers.

Cat. MB-3650 $19.95

iPod USB Data Cable

Attention PC users!
A replacement cable for a lost or broken iPod data cable. Works with all iPods that use the 30 pin Apple connector. Commonly used on Windows computers.

Cat. WC-7692 $14.95

iPod Firewire Data Cable

Cat. WC-7690 $14.95

USB 2.0 Multimedia Speaker Pair

These trendy two channel speakers plug into your computer's USB port. No need for messy cabling or external power supplies like conventional multimedia speakers.

Cat. XC-5162 $34.95

5.1 PC Speaker System

Compact, stylish and functional!
This unit will accept a stereo signal, or decoded AC-3 inputs and distribute it to produce a wonderfully presented sound stage. The unit has five 2.5" satellite speakers, and a 6.5" woofer with a total system output of 55WRMS.

Cat. XC-5169 $89.95

iPod Data / Charging Cradle & Cables

Very useful!
Charge and update your iPod easily with this cradle. It will charge the battery and you can connect the USB or Firewire cable to update your playlists etc.

Cat. XC-4930 $29.95

NEW IN 2005

iPod not included

Mini Digital Video Camera

A digital camera for under $200!
This easy to use camera fits in the palm of your hand. The recorded video can be transferred to a computer for editing or simply viewed directly on any TV with AV inputs. Features include a 3.1 Megapixel software resolution for stills, 1.5" colour LCD screen, 5 layer glass lens; 32MB internal memory, SD/MMC expansion slot, 4 x digital zoom, internal microphone and lots more! **Was $199**

SAVE $20

Cat. QC-3230 $179.00

Portable USB MP3 Player

NEW IN 2005

Play music from any USB Flash Disk.
The system looks like a pair of classy portable speakers but features an in-built MP3 decoder that will play MP3 files straight from any Flash Disk. The speakers are small, light, and stylish and can go just about anywhere. The system also incorporates an external input so you can play other devices such as CD players or Walkman etc. Operates on 9 VDC and a mains plug pack is included.

Cat. XC-5161 $89.95

DUE MID OCTOBER

Wireless Internet Antenna

NEW IN 2005

Having trouble getting unwired?
This wireless modem antenna replaces the existing 'rabbit ear' on your wireless broadband modem and boosts the signal to improve coverage. It can also improve performance in difficult areas. The antenna can be mounted inside the house or in a protected outside location for optimum reception. Supplied with N type to MCX lead & mounting bracket.
- Size 135(W) x 160(H) x 30(D)mm

modem not included

Cat. AR-3274 $129.95

PCI Wireless Network Interface Card

Features include
IEEE 802.11g wireless network compatible. Interoperation with IEE802.11b 11Mbps networks
- 64/128Bit WEP encryption
- 54Mbps high speed transfer rate
- 40 - 100m indoor range
- 100 - 300m outdoor range.
- Low power consumption
- Compatible with Win98/SE/2000/ME/XP
- Plug and Play compatible

NEW IN 2005

Cat. YN-8066 $69.95

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RIBBON TWEETERS

Affordable at last!

Spectacular U.S. Stock Purchase

All Audiophiles know that ribbon tweeters are the ultimate speaker for smooth high (and very high) frequency performance.

Don't Miss Out!

Unfortunately, a good ribbon tweeter can cost between $100 and $500 to thousands for some custom German ones. Even high-end enclosure manufacturers all opt for dome tweeters simply because "ribbons" add too much to system cost.

Jaycar have made a massive stock purchase from a major US organ manufacturer who makes both pipe and electronic organs. They are an 80+ year old company and we cannot tell you who they are! They are restructuring production of their high-end organs and their stock of ribbon tweeters have been sold to us far, far below the 10,000+ factory gate price! Their massive loss is your gain.

The tweeter is made in Japan by the venerable manufacturer, Foster. The device itself has multiple ribbon diaphragm components in same-phase configuration. There are two basic types of ribbon tweeters, static or dynamic type. This product is the dynamic type which has conventional impedance (8 ohms) and is more efficient. Each speaker is supplied with a datasheet and securely packed.

Even if you do not have any specific need for a ribbon tweeter at the moment, we strongly urge you to consider purchasing it for future use. At the price we are offering, we expect OEM (manufacturer) interest. As it is a distress stock buy, quantities are limited. On many occasions in the past we have warned customers of this and the slow ones miss out.

Finally, we think that technically, two tweeters per enclosure would be the way to go. They should not be overdriven. Note also the fairly high crossover frequency.

Type:	**Regular-phase 100mm ribbon tweeter**
Power:	**20 Watts RMS (cont), 50W max.**
SPL:	**92dB/Watt.**
Freq Resp:	**6K-40KHz +/-2dB (SUBLIME!).**
Impedance:	**8Ω.**
Crossover Frequency:	**6,400Hz (12dB / Octave).**

In keeping with this suggestion, we have a special price for a set of 4 pieces.

Cat. CT-2023 $39.95EA

or buy as a set of 4 for $136.00 That's only $34 each!

NEW IN 2005

Speaker Grilles

These grilles are designed to look like mag wheels. To compliment the look of your car. They are fitted with 6 blue high brightness LEDs which create a great iridescent blue glow to enhance your installation. LEDs are less fragile than neons, so they won't blow, and they use very little power. All require connection to your car's 12V power.

6.5"	Cat. AX-3570	$9.95 pr
6" x 9"	Cat. AX-3572	$14.95 pr
10"	Cat. AX-3574	$14.95 pr
12"	Cat. AX-3576	$19.95 pr

NEW IN 2005

Surround Speaker Floor Stands

These stand are sold as a pair and are suitable for any bookshelf speaker. Black in colour, they have a sand cast triangular base and have adjustable height from 640mm to 1250mm. The speaker holding bracket is adjustable and accommodates speakers up to about 185mm wide.

Cat. CW-2850 $79.95

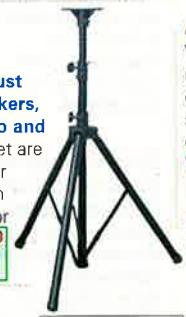
3 Piece Surround Sound Add - On

Enjoy the surround sound experience. The centre speaker contains a screened 4" mid / woofer & 2" tweeter with a 6 ohm impedence. The two rear speakers contain a 4" full range speaker with a 4 ohm impedence. **Was $99.95**

SAVE $60

Cat. CS-2465 $39.95

Heavy Duty Speaker Tripod Stand



This rugged stand extends to just under 2 metres. Supports speakers, combo amps, lighting rigs up to and around 45kilos. Tough rubber feet are mounted under each tripod leg for safe, non slip support. Made from strong aircraft grade aluminium for easy transportation and long service life.

Cat. CW-2860 $109.00

In Wall Speakers

A great mounting solution!

If space is limited, or you simply don't want free standing speakers, then these are a great option for you. 8 ohm impedance allows them to be used in an array of applications. Supplied with attractive white baffle covers.

•In ceiling speakers also available!

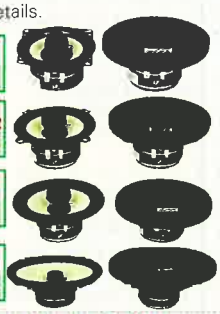
2 Way	**Cat. CS-2440 $99.00**
3 Way	**Cat. CS-2442 $149.00**

RESPONSE PRECISION Kevlar Cone Coaxial Speakers

Fantastic quality!

This new range of coaxial speakers offer high performance and great looks. They retain the large super tweeter that made last year's range great, but the new Kevlar cones take them into a realm of their own. Check out our catalogue on page 229 or our website for full details.

NEW IN 2005



4" Kevlar 2 Way •40WRMS power •86.5dB sensitivity	Cat. CS-2320	$99.95
5" Kevlar 2 Way •50WRMS power •89.5dB sensitivity	Cat. CS-2322	$109.95
6.5" Kevlar 2 Way •75WRMS power •91.3dB sensitivity	Cat. CS-2324	$119.95
6" x 9" 2 Way •80WRMS power •93.5dB sensitivity	Cat. CS-2328	$139.95

6.5" Precision Response Kevlar Splits

At their incredible price, these speakers sound every bit as good as sets two and three times the price

This new range of coaxial speakers offer high performacne and top value for money. They contain a massive super tweeter and a quality kevlar woofer. Check out our cataolgue and website for full details.

Cat. CS-2329 $149.95 pr

2.4GHz Wireless Audio Video Senders

Watch cable TV all over the house!

Send a signal from a DVD player, set-top box etc., to another room, without the use of any cables! You can use as many receivers as you like, without degrading signal quality. Each unit comes supplied with stereo audio and video transmitter and receiver, mains plugpacks & RCA cables. Transmission range is up to 100m, but depends on the type of construction materials used.

Was $99

Cat. AR-1832 $69.95

SAVE $29.05

Extra receiver to suit Cat. AR-1833 **Was $69**

Cat. AR-1833 $49.95

SAVE $19.05

As Above but with Remote Control Extender

With the addition of an IR remote control repeater you can change the channel of the source device etc from the other room.

Was $139

Cat. AR-1830 $89.95

SAVE $49.05

Extra receiver to suit Cat. AR-1831 **Was $89**

Cat. AR-1831 $69.95

SAVE $19.05

CAR AMPLIFIER DEAL

Celebrate our hot new car audio range! Buy any of our amps together with any of our top quality splits and receive a massive 25%* off full retail price on power and speaker cable purchased at the same time!

*Does not apply to already discounted cable prices.

Check out our massive amplifier range

RESPONSE PRECISION

Amplifiers

2x80WRMS

2 x 80WRMS @ 4 ohms
2 x 100WRMS @2 ohms
1 x 200WRMS @ 4 ohms

Cat. AA-0420 $169.95

4x50WRMS

4 x 50WRMS @ 4ohms
4 x 80 WRMS @ 2ohms
2 x 160WRMS @ 4 ohms

Cat. AA-0422 $199.95

2 x 150WRMS

2 x 150WRMS @ 4 ohms
2 x 255WRMS @2 ohms
1 x 500WRMS @4 ohms

Cat. AA-0424 $249.95

4x100WRMS

•4 x 130WRMS @ 4 ohms
•4 x 190WRMS @ 2 ohms
•2 x 380WRMS @ 4 ohms
Icon - respnse precision

Cat. AA-0426 $299.95

800WRMS Class D

1 x 400WRMS @ 4 ohms
1 x 700WRMS @ 2 ohms
1 x 820WRMS @ 1 ohm

Cat. AA-0428 $399

GIFTS & GADGETS

REMOTE CONTROL FUN

Multi-function Vacuum Cleaner
SAVE $20

Sit back and relax while your robot cleans the house!
It automatically moves around obstacles, and an intelligent optical sensor assists in avoiding walls and obstructions. Works best to supplement your manual cleaner, not replace it.
Was $199

Cat. GH-1395 $179

Scream Machine
Scare the daylights out of someone when you activate the scream box. It will shriek one of six sounds out loud, and they won't know it is you pressing the button!

Cat. GH-1083 $19.95

Remote Controlled Giggle Machine
Put a smile on someone's dial! Just press the remote control for one of six amusing giggles to get eveyone laughing.

Cat. GH-1085 $19.95

New Improved Fart Machine
Our best fart machine yet!
With twice as many realistic sounds as our regular model, this new fart box is sure to shock everyone at a party with disgusting realism.

Cat. GH-1087 $19.95

Remote Controlled High Speed Demolition Derby Jeep
NEW IN 2005

This is one tough cookie! Smash it, crash it and it still comes back for more. Every panel on the car is detachable and can miss-align, fly open or even come off in a crash. Suitable for ages 10 up. Red model also available GT-3202

Cat. GT-3200 $59.95

Nicky the Remote Control Clownfish
SAVE $10

Nicky the Remote Control Clownfish will add colour and delight to your fish tank.
It is a realistic looking fish which can be manoeuvred left, right, forwards or backwards. Requires 3 x AAA batteries (not included)
Was $29.95

Cat. GT-3225 $19.95

Mini Remote Control Yellow Submarine
SAVE $5

Due to popular demand, we have extended our remote control range to include the mini remote control yellow submarine!
Have hours of fun making the submarine chase the fish or why not play with it in the bath tub or pool. Hours of fun for young and old! Blue model also available GT-3045
Was $24.95

Cat. GT-3044 $19.95

Shocking Battle Tanks
SAVE $20

No Guts - No Glory'.
These futuristic battle tanks actually pack a punch and you will cop a mild electric shock if your tank gets a direct hit from your opponent.
Was $99.95

Cat. GH-1099 $79.95

3 in 1 Mars Rover, Boat & Submarine

Built to tackle difficult terrain, this versatile vehicle will get you through almost anything. It is actually three vehicles-in-one and will travel over land and, when the wheels are released, it will skim across the water as a boat or dive under it like a submarine. 4 x AA batteries are required for the vehicle 3 x AAA for the remote.

Cat. GT-3420 $49.95

Remote Controlled Hovercraft
This is really a very shallow-draft boat designed to look like a hovercraft.
It's not designed to operate on land, but on the water, it is a speedy little craft that is very manoeuvrable and will zip around the bath tub, pool or fish pond at surprising speed. The craft has an internal battery that is charged from the battery box supplied with the package.
Requires 6 x AA batteries available separately. Use our SB-2425 4 packs.

Cat. GT-3410 $29.95

LIGHT UP GADGETS

LUXEON TORCHES

1 Watt Luxeon LED Torch
Heavy duty aluminium, it is lightweight and robust.
Requires 3 x AA batteries not included. **Was $59.95**
SAVE $30

Cat. ST-3333 $29.95

3W Luxeon LED Torch
The torch head rotes to change from narrow or to a wide angle beam concentration.
Requires 3 x AA batteries.

Cat. ST-3334 $89.95

Silver 5W LED Aluminium Torch
This LED emitter is the highest flux LEDs in the world delivering the brightest solid-state lighting solutions available.
NEW IN 2005

Cat. ST-3338 $129.95

5 Watt Torch
Finished in heavy duty aluminum, it produces blinding white light.
Requires 6 x AA batteries **Was $159**
SAVE $59.95

Cat. ST-3339 $99.95

Luxeon Head Torch
This head torch is sure to outlast any conventional incandescent torch.
Requires 3 x AAA batteries

Cat. ST-3321 $69.95

GREAT NEW PARTY LIGHTING RANGE!

Disco Party Light Set
Create your own dance party atmosphere!
Get your party started the right way with some creative lighting to help set the mood. Just add music and you're set! All mains powered. Kit contains:
- 20cm mirror ball.
- 1RPM mirror ball motor.
- PAR36 spotlight.
- PAR36 globe.
- 4 x coloured gels for PAR36.

NEW IN 2005 Cat. SL-2978 $69.95

Lighting Clamp
Sturdy mounting!
Lighting clamps are used for securing pinspot lights and accessories to lighting stands. Measures 78(L) x 45(D)mm.

Cat. SL-2969 $4.95

PAR36 Spotlight with Colour Wheel & Motor
Set the mood!
The advanced screw-cap globe holder design, is much better than the older spring-clip style. The 245mm five-colour wheel and motor is easily mounted for simple installation.
- Globe not included. Use SL-2964 $9.95

Cat. SL-2963 $44.95

PAR56 300W Spotlight
NEW IN 2005

Heaps of power!
Great for theatrical and effects lighting, it includes an adjustable mounting bracket, quick change gel holder, and an 800mm mains lead.
- Globe not included. Use SL-2977 $34.95

Cat. SL-2974 $49.95

75W Strobe Light
NEW IN 2005

Super bright!
This features a super bright 75W flash tube and can be timed with music or independently. Designed for domestic use only

Cat. SL-2999 $79.95

Mini Strobe Light
Great for parties!
Features a variable flash rate up to 10Hz, and is mains powered. Uses a Xenon flash tube, and measures 85(W) x 50(H) x 125(D)mm.
Was $29.95
SAVE $5

Cat. SL-2990 $24.95

FOR INFORMATION AND ORDERING
TELEPHONE> 1800 022 888 INTERNET> www.jaycar.com.au

GIFTS & GADGETS

The Amazing Flygun!

Keep the kids entertained!

The Amazing Flygun is a safe, fun, and effective method of killing flies and mosquitoes. Launch the spring powered swatter at your target! It is safe, fun and really does work!

Cat. YS-5545 $7.95

SAFE FOR AGES 8 AND UP

UHF TRANSCEIVER DEAL

40 Ch UHF CB Transceiver

SAVE $5

New low price!

This lightweight handheld transceiver is suitable for all manner of professional and leisure activities. This is a quality UHF radio and, whilst just 0.5W output, it is NOT a toy. Open field transmission range is up to an incredible 5km, with typical city range up to 1km.

Was **$39.95** Cat. DC-1010

$34.95ea or buy 2 for $59.95

Remote Controlled Massage Seat Cover Pad

Don't wait until you get home for that well deserved massage this massage pad can deliver straight away! Designed to be used in the car, home or office, it is lightweight to take anywhere with you. It fits over most seats thanks to its elastic straps. It also has a built-in heater and 3 variable intensity levels to make your massage that much more comfortable.

Cat. GH-1753 $49.95

Intelligent Automatic Rubbish Bin

Hands full? No worries!

Just wave your hand, foot, or whatever you can in front of the intelligent rubbish bin and the lid will open automatically! It will also close back up again, so you never need to touch it. 23L capacity.

Cat. GG-2315 $39.95

Bathroom Scales with Electronic Body Fat Analysis

SAVE $30

Do you know how much excess body fat you are carrying, or are you one of the lucky few who are within healthy limits.

These excellent scales can be calibrated for use by 8 different people. The scales use 'body mass index' to measure the body fat content of each person to within 0.5%. Requires 2 x CR2032 batteries included. Was **$89.95**

Cat. QM-7249 $59.95

Ionic Shoe Dryer

NEW 2005

Eliminate odours from your shoes with this innovative Ionic Shoe Dryer.

As you wear your shoes, the dampness of your feet as well as weather conditions can cultivate the growth of mould, fungus and other assorted microbes. Controlled by a micro-computer, it adopts an advanced "ionic breeze technology" which will neutralize the odour and eliminate the nasty growth.

Cat. GH-1194 $29.95

Ionic Air Purifier

Better overall health.

This ionic air purifier is much more than just an effective odour removing air purification system. It silently fills the air with negative ions which research shows can help promote good health and improve vitality.

NEW 2005

Cat. GH-1196 $69.95

Negative Ion Generator with Filter

NEW 2005

Create fresh clean air in your home or office with this air purification system with negative ion generator. Ultra modern in design and with silent operation, this is possibly the world's thinnest air purifier, effectively capturing airborne pollutants and allergens to give you a healthy clean environment.

Cat. GH-1198 $99.95

ALARMS / SECURITY / ACCESS CONTROL

Four Zone Security Alarm System with Simple Two Wire Hookup

NEW 2005

The alarm is so simple to set up that DIY enthusiasts will love it!

All system components (sensors, sirens) are connected to the control unit via a two-core non-polar flat wire.

The unit has a built-in keypad with status LED and three modes or operation (Home, Out, Off).

Supplied with: •Main control unit •Two PIRs
•Four Door or Window contact reed switch
•External Siren
•240VAC Adaptor
•50m two-core flat wire and clips
•Screw/wall plug packs
•Main unit: 160(H) x185(W) x35(D)mm
•Extra PIR to suit LA-5476 $29.95

Cat. LA-5475 $199.00

3 Zone Wireless Home Alarm

Ideal for tennants! The system is supplied with a control panel equipped with keypad, and a built-in siren. It also comes with a wireless PIR, reed switch, and panic button which operate within a 50m range. There are also provisions for hard-wired expansion if desired. See our catalogue or website for full specifications.

Cat. LA-5125 $199.00

Wireless Intercom with Door Strike Release

Open the door from anywhere! This great unit acts as an intercom, with a wireless receiver. Take it out the back, or around the house. It also has electronic door strike control, so you can let your visitors in too!

Cat. AI-5510 $129.00

Downlight Style CCD Colour Camera

Not your conventional type camera. This 1/3" Sharp CCD camera incorporates a downright holder for flush mounting on any ceiling or flat surface. This camera is a perfect alternative to conventional Dome type cameras. It provides 0 - 90 degree adjustable pivoting camera head for securing that perfect angle. Holder is finished in polished metal giving a classy and stylish look.

Cat. QC-3503 $249.95

Weatherproof Colour Reversing Camera for Cars

Reversing made safe!

With the use of a screen or monitor, you can obtain much better vision than otherwise possible. It mounts flush into your bumper bar or similar, and is powered straight from 12VDC. See installation article in April Silicon Chip.

Cat. QC-3452 $149.00

RFID Access Control System

No contact required!

Control entry to a doorway, or an entire building. The unit can be used in a network of locks administered by a central location, or just to control access through a front door. It is 12V powered, so you can use it in remote locations, and the reader unit is splash proof.

•5 RFID cards included.
•N.O. and N.C. relay contacts.

Cat. LA-5120 $199.00

Realistic Dummy Dome Cameras

Extremely realistic!

Both models can have standard board cameras fitted to make them real working cameras.

Corner Mounting Dummy Camera

Metal mounting for stability.

Cat. LA-5312 $29.95

Dome Dummy Camera with Right Angled Bracket

Highly noticeable for maximum deterrent.

Cat. LA-5311 $19.95

SOLAR POWER & MORE

WE HAVE A MASSIVE RANGE OF INVERTERS

Pure Sine Wave Inverters

Great reliability! Pure Sine Wave inverters provide a mains waveform that is much closer to that of conventional mains supplies. This is much better and sometimes required when powering sensitive equipment, some switchmode power supplies etc.

Power	Surge	VDC	VAC	Cat. No.	Price
150W	(300W)	12	to 230	MI-5080	$229

Suits battery chargers, fax machines etc.

300W	(500W)	12	to 230	MI-5082	$289

Suits laptops, lamps and fluorescents up to 300W, 34cm TVs etc

500W	(1000W)	12	to 230	MI-5085	$329

Suits power tools, laptops, microwaves, blenders, small fridges etc

1000W	(2000W)	12	to 230	MI-5088	$799

Suits Hi-Fi systems, computers, 68cm TVs, lighting, fridges etc!

1500W	(2500W)	24	to 230	MI-5089	$999

Suits large TVs, many power tools, lighting, computers and more

Modified Square Wave Inverters

Great value! With a host of safety features such as overload & short circuit protection, dielectric isolation between the battery and secondary voltages and more. They all have excellent surge ratings and boast over 90% efficiency.

Power Surge	VDC	VAC	Cat. No.	Price
100W (300W)	12	to 230	MI-5100	$39.95

Suits battery chargers, small lights, and low power devices **WAS $44.95 SAVE $5**

150W (450W)	12	to 230	MI-5102	$48.95

Suits battery chargers, fax machines etc!

300W (1000W)	12	to 230	MI-5104	$99.95

Suits laptops, lamps & fluorescents up to 300W, 34cm TVs etc **WAS $119.95 SAVE $20**

400W (1200W)	12	to 230	MI-5106	$159.95

Suits laptops, lamps & fluorescents up to 400W, 54cm TVs etc

400W (1200W)	24	to 230	MI-5107	$169.95

Suits laptops, lamps & fluores to 400W, 54cm TVs & more from 24V

600W (1500W)	12	to 230	MI-5108	$249.95

Suits power tools, 68cm TVs, laptops, microwaves, small fridges etc

800W (2000W)	12	to 230	MI-5110	$299.95

Suits power tools, 68cm TVs, blenders, small fridges, microwaves etc

1000W (2500W)	12	to 230	MI-5112	$399.95

Suits Hi-Fi systems, computers, 68cm TVs, lighting, fridges etc

1500W (3500W)	12	to 230	MI-5114	$599.95

Suits large TVs, many power tools, lighting, computers etc

Small Solar Panels

Ideal for charging SLA batteries!

Supplied with reverse current diode, 2m lead with alligator clips.

12V 1.26 Watt

Cat. ZM-9016 $39.95

12V 4.5 Watt

Cat. ZM-9018 $99.95

Smart Solar Battery Charger

In sunlight, it supplies 15V at around 100-120mA of current.

This is enough to keep a 12V battery that is infrequently used topped up. Its ideal for that second car, ride on lawnmower, tractor, boat, etc, etc. It's housed in a plastic case, and has an output lead to cigarette lighter plug, with a LED.

•Size 370(L) x 160(W) x 20(D)mm

Cat. MB-3501 $49.95

20 Amp 12V Super Solar Panel Regulator

With a massive 20 amp current handling, this switchmode solar panel generator does not require a heatsink. It installs easily, is lightweight and features automatic operation, LED power indication and boasts an efficiency up to 99.2% @ 20 amps. Not only does the regulator switch the solar panel in and out depending on the battery voltage, the regulator will disconnect the solar panel after approx 20 minutes at night fall to prevent any losses into the panel overnight.

Cat. MP-3126 $69.90

12V 5A Battery Charging Regulator for Solar Panels

Designed for efficiently charging 12V batteries using solar cells rated up to 5-amps.

It is easy to wire-up, prevents battery discharge during low sunlight and indicates charging and full battery conditions using a yellow and green 3mm LED respectively. Ideal for charging 12V SLA batteries from solar panels up to 60W. 5-amp fuse and fuse holder recommended - not supplied

Cat. AA-0348 $29.95

12V Solar Battery Charging Regulator

This charging regulator is suitable for charging 12V lead-acid batteries. It is able to use power from a number of sources including: a 12V solar panel, or a filtered DC supply from 13.8V to 15V. Charging current and voltage are automatic, so it is ideal for charging batteries used in caravans, weekend houses and alarm system batteries. It also features reverse-current protection.

Cat. AA-0258 $22.95

High Current Power Connectors

You'll find this connector in many 4WD applications, boating, automotive and other industries. Supplied individually with a pair of contacts and rated to 600V.

Current	Poles	Cat	Price
30 Amp	2	PT-4405	$5.95
50 Amp	2	PT-4420	$12.95
120 Amp	2	PT-4422	$28.95
175 Amp	2	PT-4424	$37.95

Cat. PT-4405

Cat. PT-4420/22/24

SOLAR PANELS

Amorphous Type Solar Panels

Very affordable!

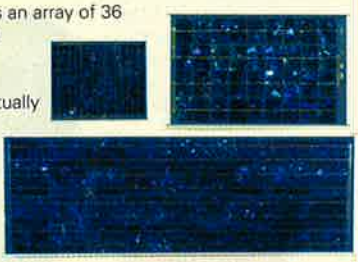
These are Amorphous Silicon type solar panels offering excellent quality, and value for money.

Be aware of cheap Amorphous solar panels which will simply not give the claimed output power. All our panels will give claimed power at 33.5°S latitude, ie, Sydney. Amorphous power output gradually decreases over the years, unlike polycrystalline which do not.

Voltage	Power	Cat No.	Price
6 Volt	1 Watt	ZM-9020	$29.95
12 Volt	2 Watt	ZM-9024	$39.95
12 Volt	4 Watt	ZM-9026	$69.95
12 Volt	10 Watt	ZM-9030	$139.00
12 Volt	15 Watt	ZM-9045	$199.00

BP Solar 12V Polycrystalline Solar Panels

Top quality panels at a great price!



Each panel has an array of 36 Polycrystalline cells, and can charge 12V batteries in virtually any climate. They are built to last, and designed to withstand a 25mm hail stone travelling at terminal velocity. They are mounted in an anodised aluminium frame that is weather proof and corrosion resistant. See website for full details.

Power	Warranty	Cat	Price
10W	10 Year	ZM-9060	$235
20W	10 Year	ZM-9062	$359
80W	20 Year	ZM-9069	$799

Want to use Solar but Don't Know How?

We have books to help you!

Solar Electricity
Find out everything you need to know about solar systems.

Cat. BE-1532 $34.95

Build Your Own Direct Charging Plant
Explains charging systems for remote and mobile power installations.

Cat. BE-1530 $24.95

4 Pack Ni-MH Rechargeable Batteries

NEW for 2005

Buy in packs and save!

These rechargeable batteries are supplied in four-packs for convenience, and are cheaper than buying them individually!

AAA 900mAh	Cat. SB-1739	$11.95 Pkt 4
AA 2,000mAh	Cat. SB-1737	$15.95 Pkt 4
AA 2,400mAh	Cat. SB-1735	$19.95 Pkt 4

Bulk Pack Alkaline Batteries

These bulk packs represent excellent value for money.

We have them made to the same specifications of those well known expensive brands advertised on TV, but at a realistic price. With a shelf life past the year 2010 you cannot go wrong!

AAA Alkalines	Cat. SB-2331	Bulk Pk of 24	$12.95
AA Alkalines	Cat. SB-2330	Bulk Pk of 24	$12.95
AA Alkalines	Cat. SB-2332	Bulk Pk of 40	$19.95

FOR INFORMATION AND ORDERING

TELEPHONE> 1800 022 888 INTERNET> www.jaycar.com.au

New "Nite Ize" Maglite™/Torch Accessories

Nite Ize accessories suit AA Maglites™ and small torches (not included).

Bite Light Adaptor

NEW IN 2005

Simple but effective!

This attachment fits over the end of your torch with a patented mouth piece to allow you to safely bite down on it to hold the torch in place. It also includes a neck lanyard.

Cat. ST-3405 $7.95

Belt Pouch

NEW IN 2005

Not your average belt pouch!

Not only can you store your torch on your belt, but with real world use in mind it has a small pouch to carry two spare AA or AAA batteries. Made from strong Nylon.

Cat. ST-3408 $6.95

7" Fibre Optic Adaptor

NEW IN 2005

Thin and flexible!

Light only travels in straight lines, but you can make it bend with this Fibre Optic adaptor. A small attachment fits right over the head of your torch to give you a flexible light source for inspecting in tight places. 3mm diameter cable.

Cat. ST-3410 $14.95

LED Upgrade Kit for Maglites

NEW IN 2005

Better efficiency! Upgrade the bulb in your AA Maglite™ to this unit that has 3 LEDs. Because LEDs are so efficient, you get four times longer battery life, and LEDs don't blow! This is the single best upgrade to a torch you can make!

Cat. ST-3400 $14.75

5mm Red 12V LED 300MCD

The perfect LED for the car!

At last a 5mm LED that can be used in a car that does not need a dropping resistor.

Cat. ZD-1784 $1.60

10mW Green Laser Module

Extremely bright!

This laser module consists of a 10mW laser diode, lens, and driver PCB. Simply connect a 3VDC supply, & you have a great high power laser. •Datasheet included. •Measures 65(L) x 11(dia)mm.

Cat. ST-3117 $149.95

Laser Level with Tape Measure

NEW IN 2005

You'll love this laser level with tape measure. Use this tool to hang pictures, paintings or mirrors in your home, install shelving, lay tiles etc. The range of the laser line projects up to 6m indoor and covers an arc of 45 and 90 degrees. The unit incorporates a horizontally spread laser to create illuminated guide lines along walls, horizontal and vertical levels. It also includes a handy 2.5m tape measure as well as a ruler on the side.

Cat. ST-3113 $39.95

4 Channel USB Datalogger

No more serial!

Record DC and slow-moving signals over very long periods. It connects to a PC via the USB port to display real time information, as well as record it. No additional power is required. There are four DC-coupled input channels, monitored at up to 100 samples/second (globally). It has a host of great features,-just check out our website.

NEW IN 2005

Cat. QD-5000 $139.95

BUY THIS: Goot Antistatic Temperature Controlled Soldering Station

Cat. TS-1440 $229.00

High temperature stability and antistatic properties make it ideal for all sorts of soldering work.

THAT'S $35.20 VALUE ABSOLUTELY FREE!

GET THESE FREE:

Metal Desolder Tool
TH-1862 $15.75

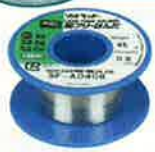
Soldering Iron Tip Conditioner
TS-1512 $6.50

Soldering Iron Tip Cleaner
TS-1510 $12.95

Lead Free Solder

Works just as well as ordinary solder but contains no harmful lead.

Supplied on a 45gm roll with handy cover and available in two sizes.
NS-3082 0.9mm dia.
NS-3084 1.0mm dia.



Cat. NS-3084 $15.95

Cat. NS-3082 $15.95

Duratech Temperature Controlled Soldering Station

SAVE $20

Very affordable!

It features a high quality ceramic heating element for accurate temperature control, adjustable between 200° & 480°C. The soldering pencil is lightweight so it is comfortable for long periods. It is a great station, so check our website for details. **Was $99**

Cat. TS-1560 $79.00

True RMS Auto Ranging RS-232 DMM

NEW IN 2005

Features a groovy blue backlit screen, and a host of features.

Includes optical RS-232 computer interface and PC software to store measurements on your home, workshop, or notebook computer for later analysis. Please see our website or catalogue for full specifications.

Cat. QM-1537 $99.95

Attn: All You "Tim The Toolmen" (The Wealthy Ones Anyway)

NEW IN 2005

We now stock the US-Designed Grabit damaged screw removal tool, but BOY it's expensive!! **What it does.** If you have a typically, (but not necessarily) countersunk screw that is slotted, Phillips, Posidrive, Torx, Tri-Wing, tamper resistant, etc that is **totally** stripped out, this product will get it out - even if the head is **totally** hollow! All of us "Tims" have experienced this! The extraction bit consists of a burnishing bit that basically preps a tapered hole in the screw head. You turn the bit around with the extractor bit out, reverse the cordless drill direction and the extractor bit bites into the prepped hole with tremendous force. Works equally well on brass, steel, stainless screws etc. The TD-2059 consists of two 1/4" hex drive bits that cover screws from #6 to #14 gauge. In days when a 12V cordless drill can retail for $25 this product may seem expensive. What it can do for you is priceless.

Cat. TD-2059 $49.95

Super Bright 1 Watt LED Star Modules

These LEDs are just as bright as the leading brand but cost a whole lot less.

They are increasingly finding their way into general and architectural lighting applications and with a service life of 100,000 hours. They provide up to 25 lumens per watt and are available in anumber of colours.

1 WATT $12.95

3 WATT $23.95

Super Bright 1 Watt LED Star Module - Red
Cat. ZD-0500
Super Bright 1 Watt LED Star Module - Amber
Cat. ZD-0502
Super Bright 1 Watt LED Star Module - Green
Cat. ZD-0504
Super Bright 1 Watt LED Star Module - Blue
Cat. ZD-0506
Super Bright 1 Watt LED Star Module - White
Cat. ZD-0508
Super Bright 1 Watt LED Star Module - Warm White
Cat. ZD-0510

Super Bright 3 Watt LED Star Module - Red
Cat. ZD-0520
Super Bright 3 Watt LED Star Module - Amber
Cat. ZD-0522
Super Bright 3 Watt LED Star Module - Green
Cat. ZD-0524
Super Bright 3 Watt LED Star Module - Blue
Cat. ZD-0526
Super Bright 3 Watt LED Star Module - White
Cat. ZD-0528
Super Bright 3 Watt LED Star Module - Warm White
Cat. ZD-0530

Collimator

A collimator is an optical device which is designed to produce a light beam in which the the rays are parallel, or at least very near parallel.

While we normally consider LEDs to be very focused in terms of light spread, in many applications there is still a vast quantity of "wasted" light spread.This series of collimators are designed to suit our Star LED modules (lambertian LED models only) and are manufactured from quality optical components. 3 different viewing angles are available:

Collimator - 10°
10° Viewing Angle
Cat. HP-1290 $5.95

Collimator - 15°
15° Viewing Angle
Cat. HP-1292 $5.95

Collimator - 25°
25° Viewing Angle
Cat. HP-1294 $5.95

WE'RE STILL #1 FOR KITS

Dr Video Kit Mk11

An even better video stabiliser!

Ref: Silicon Chip June '04

Movie companies deliberately tamper with the video signal to restrict copying. Get the picture you paid for and strip out these annoying signals from composite or S-video. Kit includes PCB, case, panels & all electronic components.

Cat. KC-5390 $99.95

USB Power Injector

A power boost for your USB port!

Refer: Silicon Chip October 2004.

If you have a lot of peripheral devices running from your computer, they may be trying to draw more current than your USB port can provide. This project will allow full current draw no matter how many peripheral devices you are running. It uses an external power supply to tap into the existing line, effectively boosting the available current.

Cat. KC-5399 $29.95

Pro-Series 3 Stereo Power Amp Kit

Suberb amplifier for home Cinema! One Final Time - We have made 1 final batch of Pro-Series 3 Stereo Power Amp Kits.

Once these are gone, that is the end of this great amp.

We supply a superbly illustrated and thorough construction manual that takes you through step by step! The Pro 3 is supplied absolutely complete with professionally prepared paneling, pre-lined PCB s, high-quality high-current wiring plus all specified componentry. Output power is 185W RMS x 2, 8 ohm and 255W RMS x 2, 4 ohm with a THD at 0.008% at 180W RMS. See our catalogue for full specs.

Cat. KA-1760 $599

Speaker Bass Extender Kit

Ref: Silicon Chip April 2005.

Most audiophiles know that loudspeaker enclosures have a natural frequency rolloff which is inherent in their design.

The Bass Extender kit boosts the level of the bass to counteract the natural rolloff of the enclosure, producing rich, natural bass. It gives an extra octave of response, and is sure to please even the most avid audiophiles.

•Kit supplied with PCB, and all electronic components.

Cat. KC-5411 $19.95

Wireless Basketball Scoreboard Kit

NEW KIT

EXCLUSIVE TO JAYCAR!

This kit enables you to make a full-sized electronic scoreboard, in particular for Basketball but also adaptable for netball and other games.

Ref: Silicon Chip March/April/May 2005. It can be built for a fraction of the cost of commercial equivalents and has a completely wireless scoring console that can control one or multiple score-boards. You can mount the score-boards high up in the court, plug it in to a 240VAC power point and then control them from a table courtside with no messy wiring. It features Home/Away team scores 0 to 199, game period, countdown time, Home/Away time and the addition of a new 'foul' feature. It measures 900 x 600mm and comes with all pre-cut scoreboard woodwork, screen printed face, display filters, mounting plates, pre-programmed microcontroller, printed circuit boards, 2.4GHz transmitters & receivers, pre-punched control console with special piezo end-of-game quarter sounder, and all electronic components to make one scoreboard.

Cat. KC-5408 $799

Extra Scoreboards Available

Contains everything included in the original kit without parts for the control console. Cat. KC-5409 $649

YOUR LOCAL JAYCAR STORE

Freecall Orders: Ph 1800 022 888

NEW SOUTH WALES	
Albury	Ph (02) 6021 6788
Alexandria	Ph (02) 9699 4699
Bankstown	Ph (02) 9709 2822
Blacktown	Ph (02) 9678 9669
Bondi Junction	Ph (02) 9369 3899
Brookvale	Ph (02) 9905 4130
Campbelltown	Ph (02) 4620 7155
Erina	Ph (02) 4365 3433
Hornsby	Ph (02) 9476 6221
Newcastle	Ph (02) 4965 3799
Parramatta	Ph (02) 9683 3377
Penrith	Ph (02) 4721 8337
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Driveway Automatic Entry Sensor Kit

Exclusive to Jaycar Ref: Silicon Chip Nov 04

Automatically open your electronic gates or automatic garage door as you approach in your vehicle, without the use of remote controls!

It uses a large coil sensor to detect moving metal (eg a car chassis), which reduces false alarms from animals and people etc. Kit supplied with PCB, silk screened machined case, pre-wound & insulated 5000 turn coil, and all electronic components.

Cat. KC-5402 $179

Luxeon Star LED Driver Kit

Refer: Silicon Chip May 2004.

Luxeon high power LEDs are some of the brightest LEDs available in the world.

They offer up to 120 lumens per unit, and will last up to 100,000 hours! This kit allows you to power the fantastic 1W, 3W, and 5W Luxeon Star LEDs from 12VDC. This means that you can take advantage of what these fantastic LEDs have to offer, and use them in your car, boat, or caravan.

Cat. KC-5389 $29.95

Universal Voltage Switch Kit

Automatic device switching!

Use it to trigger cooling systems, fans, and more from sensors. This can include temperature sensors, throttle position sensors and more. Kit includes PCB and all electronic components.

Cat. KC-5377 $29.95

5m IR Light Barrier Kit

Excellent functionality!

This kit indicates via LED when the beam is broken. Includes PCB, IR RX/TX diodes, magnifying lens & all electronic components.

Cat. KG-9094 $11.95

Component Video to RGB Converter Kit

Ref: Silicon Chip May 2004.

Top quality home cinema is increasingly common in many houses.

The best quality picture currently available is Component Video. It is better than RGB, and outstanding against S-Video or composite. So if Component Video is the best on offer, how do you take advantage of it when your projector or plasma TV only have an RGB input? This unit will convert the Component Video signal from your DVD player etc to an RGB signal for input into your display device. It provides you with fantastic reproduction with minimal degradation. Kit supplied with PCB, case, silk-screened and punched panels, colour coded RCA sockets, 9VAC mains plugpack, and all electronic components.

Cat. KC-5388 $99.95

The SHORT CIRCUITS LEARNING SYSTEM

The Short Circuits learning system is a great way to learn electronics. It is fun, informative, and you build great projects along the way. Here is just one from Short Circuits 3...

Guitar Practice Amplifier Kit

Don't annoy the neighbours!

It has a guitar type input socket, small speaker, and volume control. It sounds great! Kit supplied with PCB, speaker, socket, and all electronic components. Instructions are in the Short Circuits 3 book.

Cat. KJ-8092 $14.50

Infrared Remote Control Tester

Check your IR remote on an oscilloscope!

Refer: Silicon Chip January 05.

When a remote control stops working, the first thing we usually do is change the batteries right? That usually solves the problem, but what if it still won't work? The days of flashing operation LEDs on most TV and HiFi remotes are gone, so the only real way to diagnose a fault is with the remote control tester. It lights an LED and sounds a buzzer when an IR code is detected, and also has an auxiliary output to connect it to an oscilloscope for further analysis.

Cat. KC-5407 $29.95

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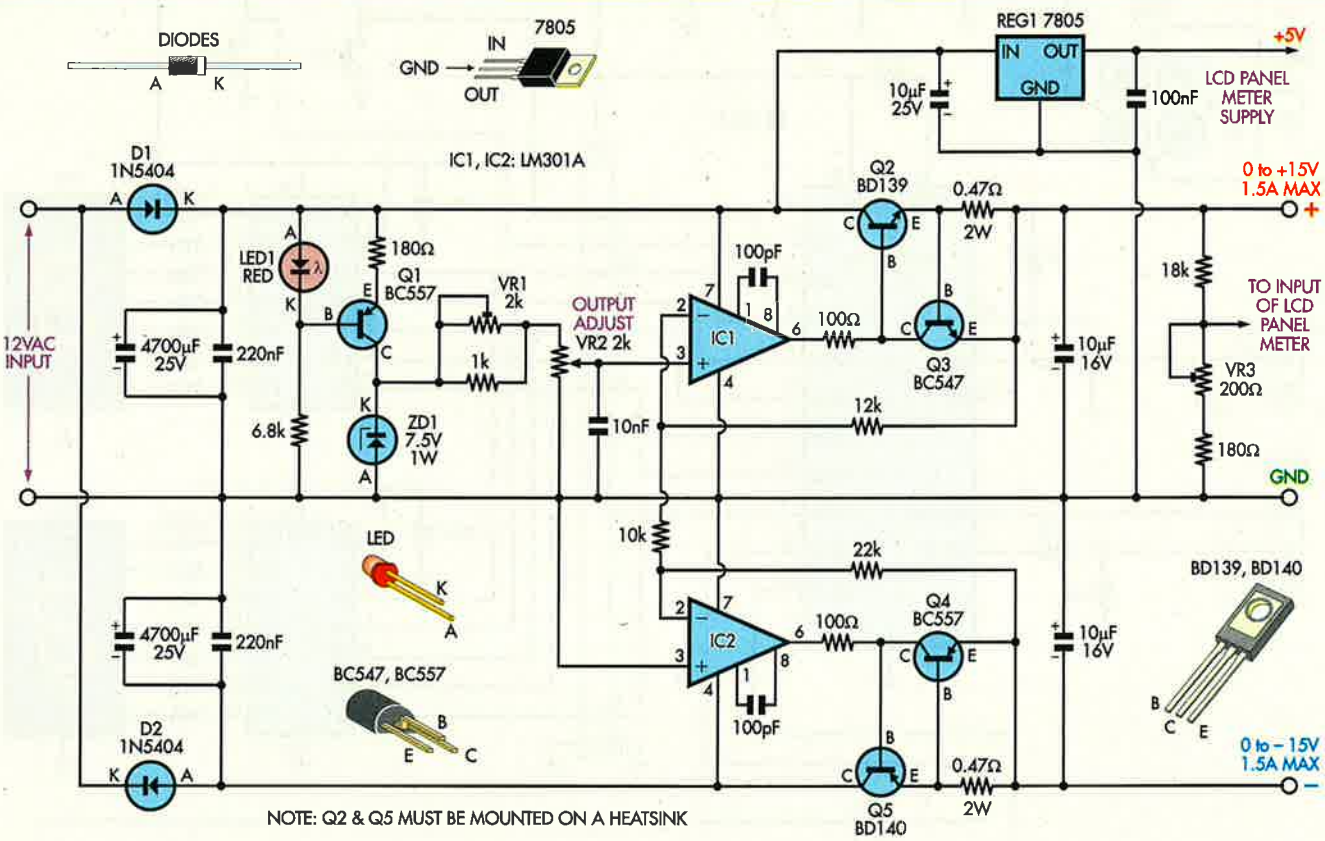
CIRCUIT NOTEBOOK

Interesting circuit ideas which we have checked but not built and tested. Contributions from readers are welcome and will be paid for at standard rates.



Discrete dual-tracking power supply

This DC power supply boasts dual 0-15V outputs with up to 1.5A current handling capability and includes over-current protection.

A 12VAC transformer provides input power, which is half-wave rectified by diodes D1 and D2 to feed the positive and negative rails. Two 4700µF capacitors provide bulk filtering.

Transistor Q1 acts as a constant current source for ZD1 to help ensure a stable 7.5V reference with varying rail voltage. The LED and the 180Ω resistor in the emitter circuit determine the current. Select a LED with a forward voltage of about 2.4V and alter the resistor value if necessary to get close to 10mA through the zener diode.

The 7.5V reference feeds the top of an adjustable voltage divider network, comprised of a trimpot (VR1) and a 2kΩ panel-mounted pot (VR2). The trimpot can be adjusted so that the maximum output voltage is 15V when VR2 is at its maximum position.

The wiper of VR2 feeds the non-inverting input (pin 3) of op amp IC1. The gain of the op amp is set to 2.2 by virtue of the 12kΩ and 10kΩ resistors connected to the inverting input. Its output (pin 6) drives the base of a series pass transistor (Q2), which is effectively inside the feedback loop. This means that with 6.8V applied to the non-inverting input, the voltage at the output of the supply should be close to 15V.

Over-current protection is provided by transistor Q3, in conjunction with an 0.47Ω series resistor. When the load current reaches 1.5A, the voltage drop across the resistor is about 0.7V, causing Q3 to conduct. This diverts current away from the base of Q2 and so reduces the output voltage.

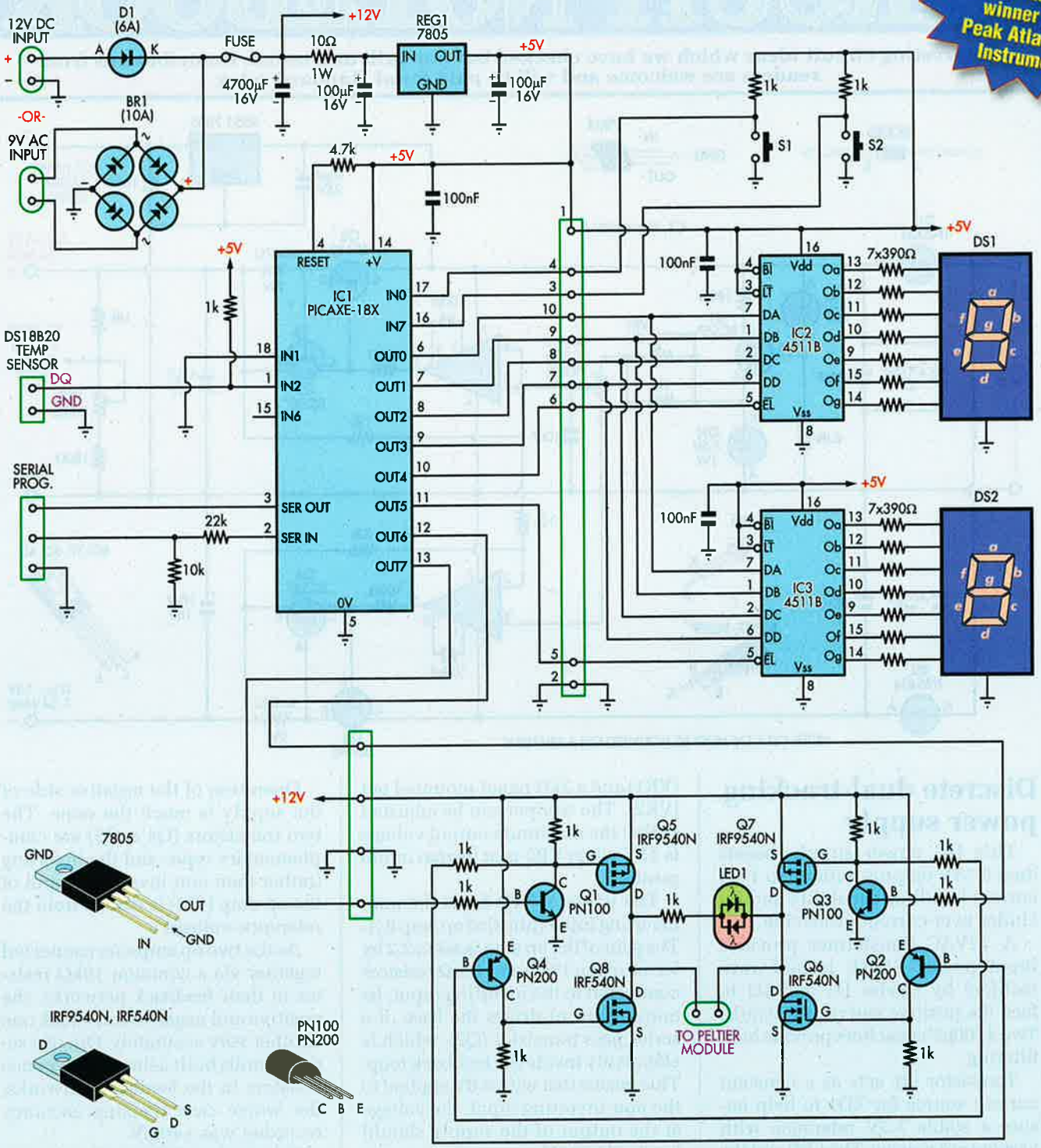
Operation of the negative side of the supply is much the same. The two transistors (Q4 & Q5) are complementary types and the inverting (rather than non-inverting) input of the op amp (IC2) is driven from the reference voltage.

As the two op amps are connected together via a common 10kΩ resistor in their feedback networks, the positive and negative rails track one another very accurately. Out of a series of units built using 1% tolerance resistors in the feedback networks, the worse case tracking accuracy recorded was ±40mV.

If desired, an LCD panel meter can be used to display the positive output voltage. A separate +5V regulator (REG1) provides power for the meter, while a resistor string incorporating a 200Ω trimpot (VR3) divides down the output to meet the ±200mV FSD meter specifications.

Rod Smith,
Bendigo, Vic. ($45)

David Crowley is this month's winner of a Peak Atlas Test Instrument



PICAXE-controlled bird brooder

This ingenious design controls the temperature in an icebox (an "Esky" or similar) so that it can be used as a bird brooder.

The circuit is based around a PICAXE-18X microcontroller, which maintains a set temperature in the icebox by controlling a Peltier module. A temperature sensor in the icebox provides feedback, while two 7-segment displays give the current or set temperature, which is alterable via two pushbutton switches.

Looking first at the temperature readout part of the circuit, the two 7-segment LED displays are driven by 4511 display drivers (IC2 & IC3), in turn driven by four outputs (OUT0–OUT4) of the PICAXE micro. The data inputs to these ICs are tied together and alternately enabled by

Program Listing

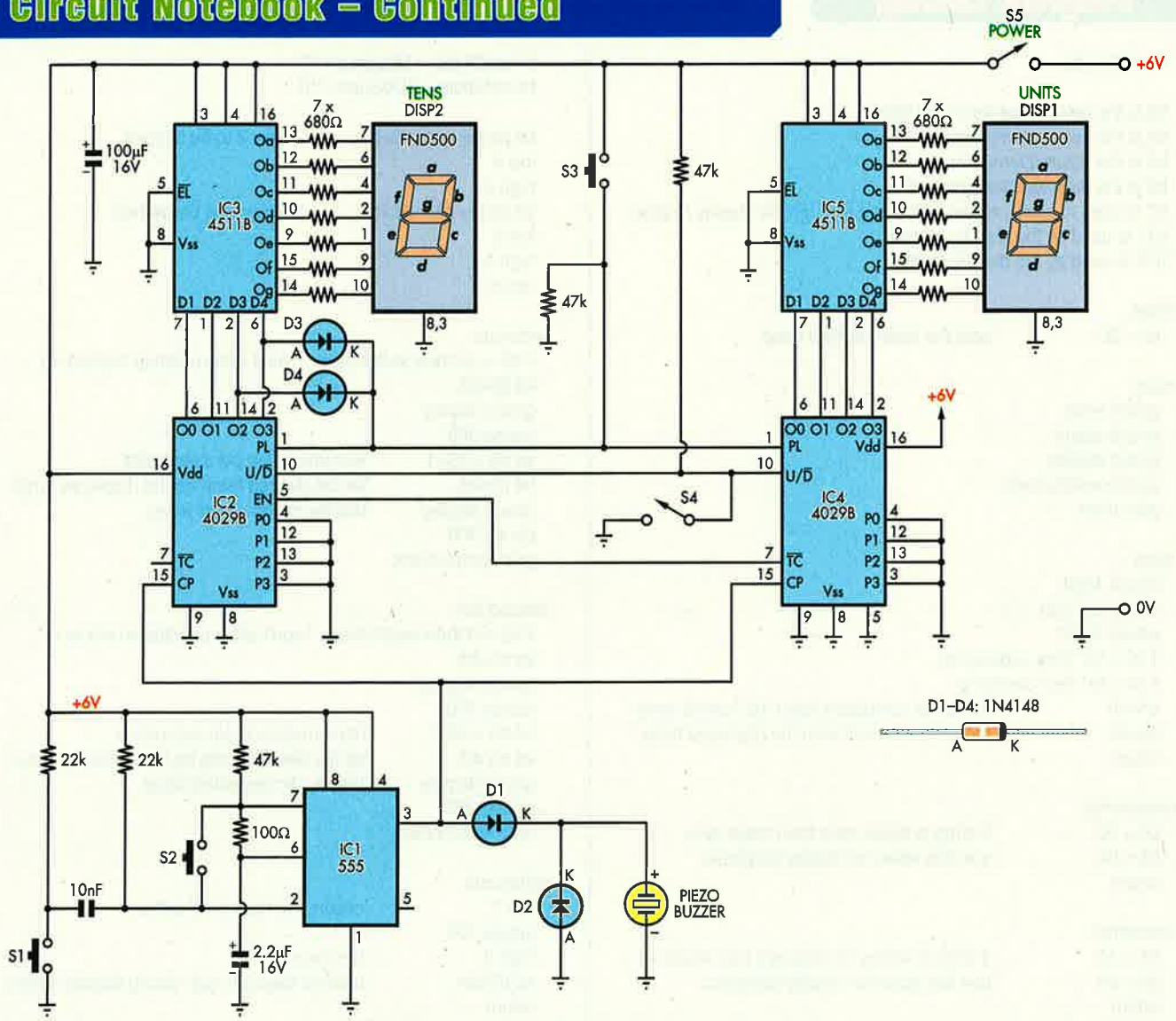
```
' Bird Brooder

' b0 is the temp value from DS18B20
' b4 is the current temperature
' b5 is the desired temperature
' b6 is the displayed temperature
' b7 is used to allow peltier to continue through the display routine
' b11 is used by the display routine
' b12 is used by the display routine

initial:
  b5 = 30              'sets the initial desired temp

main:
  gosub temp
  gosub action
  gosub display
  gosub switchcheck
  goto main

temp:
  pause 1000
  readtemp 2,b0
  pause 1000
  if b0 >127 then undertemp
  if b0 >45  then overtemp
  b4=b0                'make the calculated temp the current temp
  b6=b4                'make the current temp the displayed temp
  return

undertemp:
  b4 = 00              'if temp is below zero than make zero
  b6 = b4              'use this value for display purposes
  return

overtemp:
  b4 = 45              'if temp is above 45 degree's than make 45
  b6 = b4              'use this value for display purposes
  return

action:
  if b4<b5 then peltierhot
  if b4>b5 then peltiercold
  if b4=b5 then peltiernil
  return

switchcheck:
  if pin0 = 0 then switchdown          'pin normally pulled high
  if pin7 = 0 then switchup            'pin normally pulled high
  return

display:
  symbol bDecimal = b6
  symbol bTensNibble = b11
  symbol bUnitNibble = b12
  bTensNibble = bDecimal / 10
  bUnitNibble = bDecimal // 10

  let pins = b11+48+b7       'dislay 2 to be latched
  low 4
  high 4
  let pins = b12+48+b7       'display 1 to be latched
  low 5
  high 5
  return

switchup:
  if b5 = 45 then switchcheck  'won't allow countup beyond 45
  let b6=b5
  gosub display
  pause 300
  let b5 = b5+1        'increment one per subroutine
  let b6=b5            'let the desired temp be the displayed temp
  gosub display        'display incremented value
  pause 300
  goto switchcheck

switchdown:
  if b5 = 0 then switchcheck  'won't allow countdown below 0
  let b6=b5
  gosub display
  pause 300
  let b5 = b5-1        'decrement one per subroutine
  let b6=b5            'let the desired temp be the displayed temp
  gosub display        'display decremented value
  pause 300
  goto switchcheck

peltiercold:
  low 7                'ensure the heat is off before
  pause 100
  high 6               'turn on cool
  let b7=64            'used to keep pin high during display routine
  return

peltierhot:
  low 6                'ensure the cool is off before
  pause 100
  high 7               'turn on heat
  let b7=128           'used to keep pin high during display routin
  return

peltiernil:
  low 6                'ensure cool is off
  pause 100
  low 7                'ensure heat is off
  pause 100
  let b7=0             'used to keep pin low during display routine
  return
```

the OUT4 and OUT5 port bits.

The desired temperature is set with pushbutton switches S1 & S2, which are connected to port inputs IN0 & IN7. The switch inputs are normally pulled high via 1kΩ resistors, so if either S1 or S2 is pressed, the respective line is pulled low.

The Peltier module is driven with four power MOSFETs (Q5-Q8) arranged in a classic H-bridge con-

continued on page 65



Electronic Nim game

Nim is a two-player game of strategy in which players take turns removing objects from a heap (traditionally pebbles or matches). The players must take between one and an agreed-upon maximum number of objects per turn. The player left to pick up the last item is the loser.

Many variations on this basic set of rules can be applied. For example, the last to pick up could be the winner, or the heap could be built up rather than dismantled, with the last to place an object being the winner – or loser!

Here's an electronic version of the game that supports all four of these variations, using a 2-digit LED display instead of physical objects. The displays are driven by 4511 decoders/drivers, which receive their data from two 4029 counters.

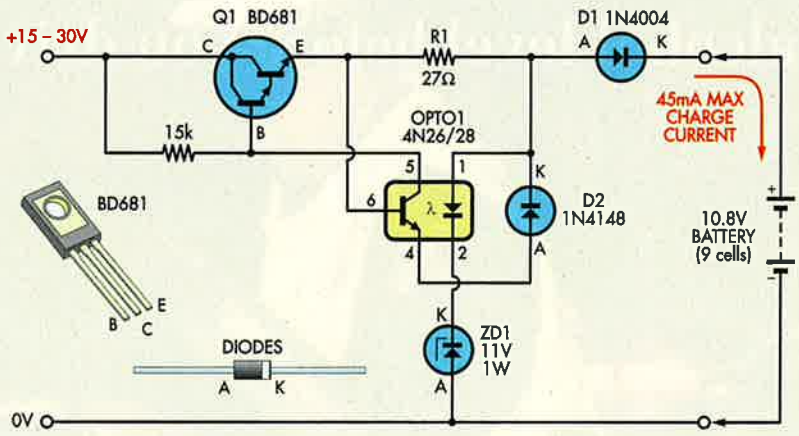
Initially, up or down counting mode is selected with toggle switch S4. The display is then cleared by pressing switch S3, which loads both counters (IC2 & IC4) with zero.

To get a random number of "objects" (ie, a random count) at the start of the game, switch S2 is pressed. This places the 555 timer (IC1) into astable (free-running) mode and causes it to produce a rapid train of pulses at the clock (CP) inputs of the two counters. A value of 39 was chosen as the maximum count, which is enforced by the connection of two most significant bits of the tens counter (IC2) back to the parallel load (PL) inputs via diodes D3 & D4.

The display count can be incremented or decremented (depending on the position of S4) by pressing switch S1, which generates a negative-going pulse at the trigger input of the 555. With the timer now in monostable mode, a single 110ms (approx.) positive pulse is generated for each switch press, clocking the counters and sounding the piezo buzzer.

People with a mathematical bent can work out a winning strategy and then show off by playing the game by ear – once they know the starting number on the display!

A. J. Lowe,
Bardon, Qld. ($45)



Trickle charger uses optocoupler

This novel NiCd/NiMH battery charger provides a constant charging current and over-voltage protection using little more than a Darlington transistor and an optocoupler.

When the voltage drop across the 27Ω resistor (R1) equals the base-emitter forward voltage of optocoupler plus the forward voltage of D2 (about 1.2V in total), the optocoupler transistor conducts. This reduces the base current of the series pass transistor (Q1), thereby maintaining the collector current at about 44mA (1.2V/27Ω = 44mA).

Should the voltage on the anode of D1 increase above the forward voltage of the LED in the optocoupler plus the reverse voltage of the zener diode (about 12.5V in total), the LED will illuminate, causing the optocoupler transistor to saturate. This pulls the base of Q1 towards ground, switching it off.

Note that Q1 must be a high-gain Darlington transistor due to the low current handling capabilities of the optocoupler. D1 prevents the battery from discharging through OPTO1 & ZD1. Both current and voltage levels can be altered by changing the values of R1 and the zener diode.

Chris Baker,
via email. ($40)

Contribute And Choose Your Prize

As you can see, we pay good money for each of the "Circuit Notebook" items published in SILICON CHIP. But now there are four more reasons to send in your circuit idea. Each month, the best contribution published will entitle the author to choose the prize: an LCR40 LCR meter, a DCA55 Semiconductor Component Analyser, an ESR60 Equivalent Series Resistance Analyser or an SCR100 Thyristor & Triac Analyser, with the compliments of Peak Electronic Design Ltd **www.peakelec.co.uk**

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You can either email your idea to silchip@siliconchip.com.au or post it to PO Box 139, Collaroy, NSW 2097.

PICAXE-controlled bird brooder . . . from page 63

figuration. Four small-signal transistors (Q1-Q4) level-shift the 5V logic outputs from the PICAXE in order to switch 12V at the gates of the MOSFETs.

When both outputs (OUT6 & OUT7) from the micro are low, the Peltier module is off. If OUT6 is programmed high, Q1 conducts, pulling the gate of the MOSFET (Q5) towards ground. Being a P-channel type, the MOSFET switches on, connecting the positive (+12V) rail to one side of the Peltier module.

On the other side of the bridge, the low voltage on the collector of Q1 also causes Q2 to conduct, which in turn drives the gate of Q6 high. Being an N-channel MOSFET, it switches on, completing a current path to ground for the Peltier module.

Thus, if OUT7 were low rather than OUT6, the polarity of the voltage applied to the Peltier device would be reversed, causing cooling, rather than heating (or vice-versa, depending on how the Peltier device is connected).

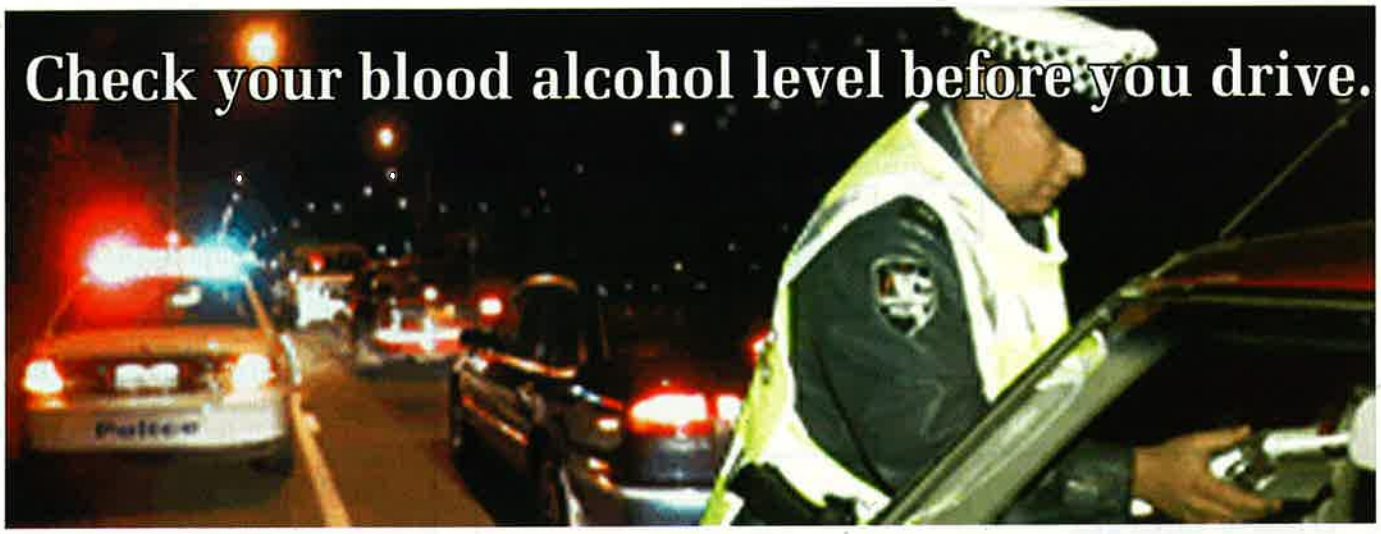
Of course, OUT6 & OUT7 must never be programmed to be high at the same time. Doing so will short-circuit the supply rail and may destroy the MOSFETs!

Temperature in the Esky is sensed with a DS18B20 digital temperature sensor. The PICAXE program continually monitors the temperature and compares it with the user-programmed value to determine if heating or cooling is required.

The prototype was constructed in three parts. A display board carries the two pushbutton switches, 7-segment LED displays and drivers; a power control board carries the H-bridge MOSFETs and related switching logic; and a main board carries the PICAXE-18X and power supply circuitry. Connection between the display and main boards is accomplished with a short length of 10-way ribbon cable.

The circuit requires a hefty 12V DC power source. This could be supplied from a car battery or heavy-duty mains adaptor, with the rating dependant on the requirements of the Peltier module. Alternatively, a supply could be built using a 9VAC mains transformer and diode bridge of appropriate ratings.

David Crowley,
Toowoomba, Qld.



RBT BAC Checker

The courts are full of people who thought they were fit to drive after having "a couple of drinks". This simple little project will give you a good indication of alcohol on your breath – and therefore your blood alcohol concentration (BAC). It's up to you then to make the right decision and get a cab home instead!

If you drive when under the influence of even a small amount of alcohol it is certain that your driving will be impaired.

Reaction times will be extended and while you may feel confident to drive, anything that occurs requiring a judgement decision may lead to disastrous consequences.

For Learner and Provisional drivers in NSW at least, there is virtually zero tolerance for having any blood alcohol levels. With this in mind, being able to detect small amounts of alcohol on your breath would be quite useful.

The SILICON CHIP Alcohol Level Meter can be used to detect and display the presence of alcohol on your breath. And it operates with sufficient sensitivity to detect blood alcohol levels below the critical 0.05% concentration.

Before we go any further, though, let's get one thing straight: this unit does not and can not replace the highly calibrated devices used by the Police. Therefore it must not be used to make the decision to drive or not to drive based on an "under .05" or "over .05" reading. Our advice would be – if you drink, don't drive!

Our Alcohol Level Meter

Housed in a small ABS case, the circuit consists of a proprietary alcohol sensor which drives a 10-LED bargraph display. The higher the proportion of alcohol sensed, the higher the display reads.

Warning

This Alcohol Level Meter does not give a calibrated blood alcohol reading and cannot be relied on to give an over-the-limit warning.

Don't be concerned about the relatively small number of components on the PC board, nor the large number of unused holes. This simple level meter doesn't need any more components. Furthermore, this particular PC board has been designed for more than one project – it has already served us in the recent "Bilge Sniffer" (September 2005).

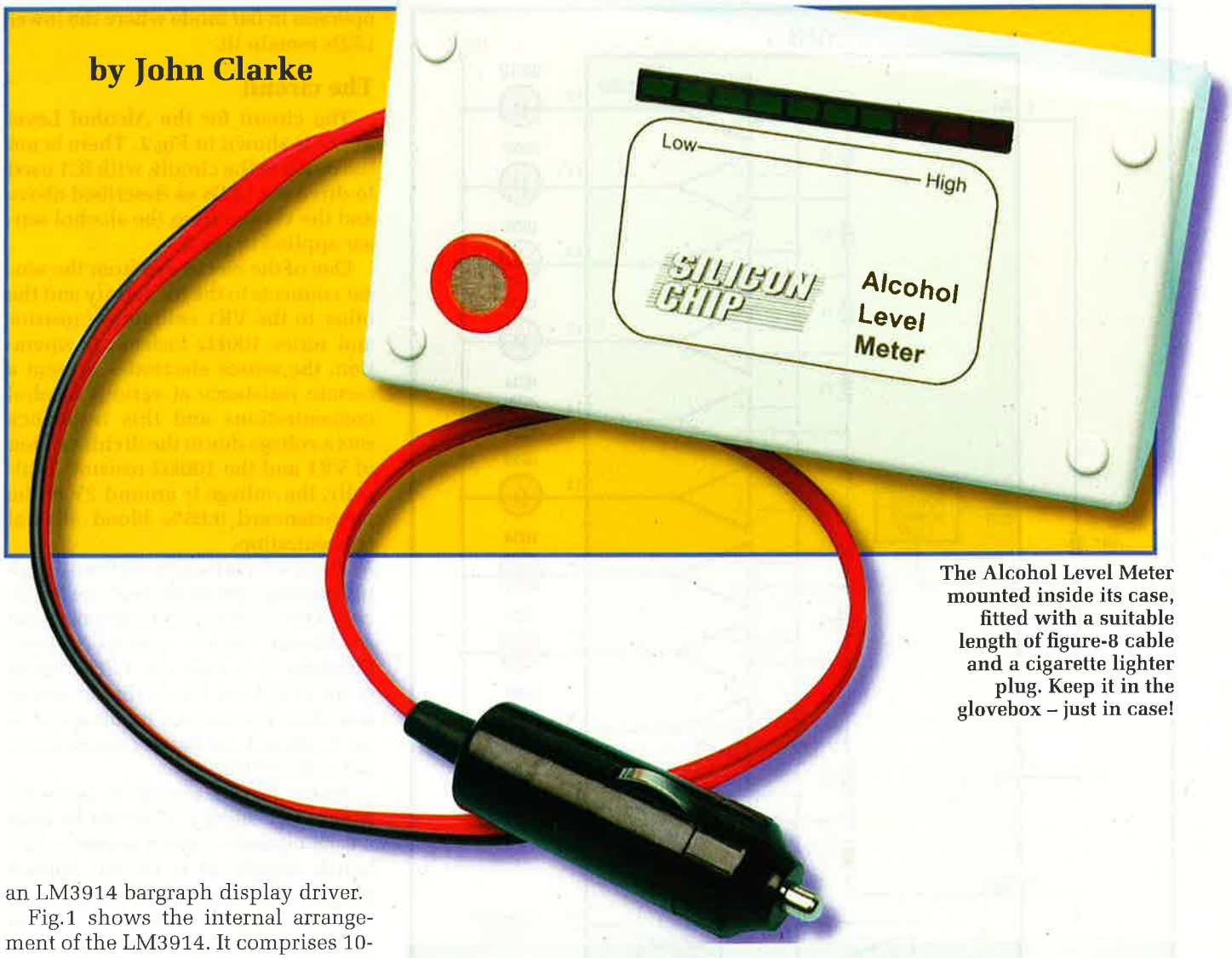
The sensor

The alcohol sensor itself, which protrudes through the case lid so that it can be blown into, is encapsulated in a plastic button-shaped housing with a stainless steel mesh covering over the open end.

Inside is a heater that is used to heat up an aluminium oxide ceramic tube, itself coated with a tin dioxide sensitive layer. Resistance across the electrodes attached to the sensitive layer *decreases* with *increasing* alcohol concentration – that is, it is an inverse relationship.

The change in resistance from the sensor is converted to a voltage by a resistive voltage divider across the supply voltage. This is then displayed using the LED bargraph, controlled by

by John Clarke



The Alcohol Level Meter mounted inside its case, fitted with a suitable length of figure-8 cable and a cigarette lighter plug. Keep it in the glovebox – just in case!

an LM3914 bargraph display driver.

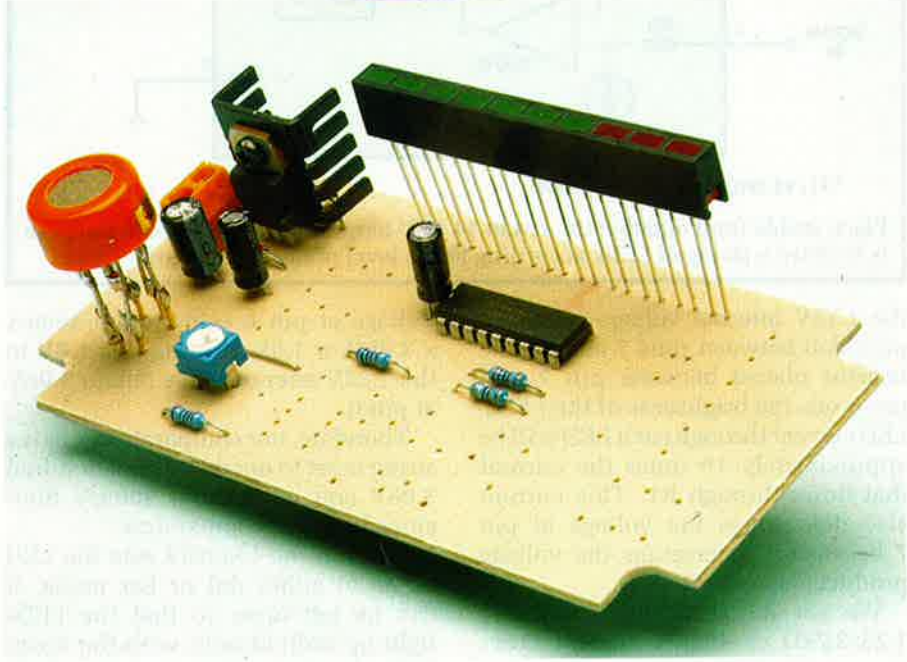
Fig.1 shows the internal arrangement of the LM3914. It comprises 10-comparators that monitor the voltage applied to pin 5.

The comparator's positive inputs are connected to 10 series-connected resistors between the RL_O and RH_I inputs. The idea is to connect the RH_I input to a voltage source and RL_O either to ground or a raised voltage if you wish to measure a range of voltage that starts above ground.

The resistor string sets each comparator input at a different voltage. So for example, if RH_I is at 1V, then the lower comparator will have 100mV at its positive input. The second comparator will have 200mV and so on until the top-most comparator will have the full 1V at its positive input.

As the input voltage at pin 5 goes above the 100mV level, then LED1 will light. Above 200mV, LED2 will light and above 300mV, LED3 will light. This sequence will continue, with LED 10 lighting when pin 5 is at 1V.

RH_I can be set to a voltage using



Here's what is inside the box: not much to it, is there? The alcohol sensor itself is on the bottom left, mounted high on PC stakes and wires so that it can peek through the case lid. The LED display is also mounted at the same height.

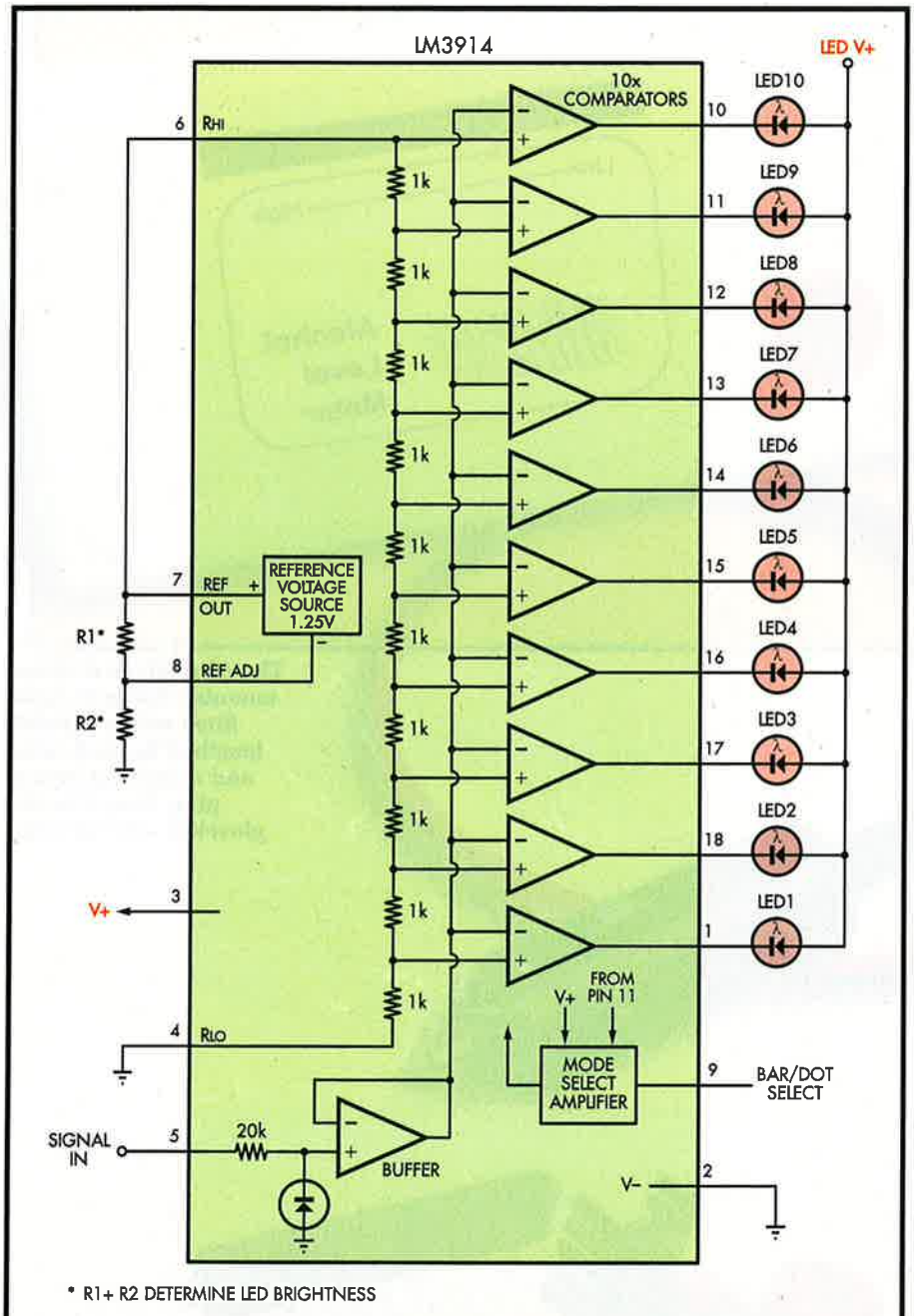


Fig.1: inside (and outside) the LM39 14 LED bargraph driver. Its sole purpose is to drive a string of LEDs according to the level of the input signal.

the 1.25V internal voltage reference provided between pins 7 and 8. The resistor placed between pin 7 and pin 8 sets the brightness of the LEDs. LED current through each LED will be approximately 10 times the current that flows through R1. This current also determines the voltage at pin 7 because it determines the voltage produced across R2.

We set R1 at 2.7kΩ so that a 1.25/2.7kΩ or 463µA current flows through R1. LED current is therefore around 4.6mA. The 463µA also flows through R2 (3.9kΩ in our circuit). Voltage at pin 8 is therefore 463µA x 3.9kΩ or 1.8V. Adding this 1.8V to the 1.25V reference, we obtain 3.06V at pin 6.

Therefore, our comparator resistive string is set to operate over a nominal 3.06V and with about 300mV divisions between comparators.

Pin 9 of the LM3914 sets the LED mode to either dot or bar mode. It can be left open so that the LEDs light up individually, with the lower LED switching off as the higher LED switches on (dot mode). If pin 9 is connected to pin 3, then the display operates in bar mode where the lower LEDs remain lit.

The circuit

The circuit for the Alcohol Level Meter is shown in Fig.2. There is not too much to the circuit, with IC1 used to drive the LEDs as described above and the voltage from the alcohol sensor applied to pin 5.

One of the electrodes from the sensor connects to the 5V supply and the other to the VR1 calibration resistor and series 100kΩ resistor. In operation, the sensor electrodes present a certain resistance at various alcohol concentrations and this resistance sets a voltage due to the divider action of VR1 and the 100kΩ resistor. Typically, the voltage is around 2V at the now-standard 0.05% blood alcohol concentration.

The sensor is heated via the 5V supply passing current through the heater coil. The coil has a 33Ω resistance and so current draw is around 150mA. Combine this with the LED current of up to around 50mA (in bar mode) and there is a current requirement of up to 200mA. So battery operation is not a good idea.

Power for the circuit is provided from a 12V supply. This can be from a car's cigarette lighter socket, a 12V bench supply or a 12VDC 500mA plugpack. The supply is reverse polarity protected using diode D1 and protected from transient voltages using a series 10Ω resistor and the 16V zener diode, ZD1.

The 100µF capacitor filters the incoming voltage. REG1 regulates the voltage down to 5V for the sensor and IC1 supply. Two 10uF decoupling capacitors are included for the output of REG1 and the LM3914.

Construction

The Alcohol Level Meter is constructed onto a PC board coded 05109051 and measuring 123 x 60mm. This is housed into a plastic UB3 box measuring 130 x 67 x 44mm. The board is held in place on indents in the side wall guides – no screws are used. For this reason, the corners of the PC board have to be shaped ("concaved") so that the PC board can fit into the box.

Power is connected via a figure-8 lead that either attaches to a cigarette lighter plug or a DC line socket.

Begin construction by checking the

siliconchip.com.au

PC board for any defects.

Solder in the resistors first, making sure the correct value is placed in the shown position. You can use the accompanying resistor colour code table to check values or use a multimeter. When installing the regulator and IC, make sure they are oriented correctly. A heatsink attaches to the regulator using an M3 x 10mm screw and nut. The heatsink flanges protrude toward the edge of the PC board.

When mounting the electrolytic capacitors and diodes, these too must be oriented with the correct polarity – refer to the overlay diagram. Terminals for the power connection and trimpot (VR1) can also be installed now.

The sensor itself can be mounted either way around, as the pin connections are symmetrical. It is mounted so that the top of the sensor is 30mm above the PC board, on PC stakes and lengths of tinned copper wire (resistor lead offcuts are ideal).

The LED bargraph has long leads and can mount directly on the PC board with the top of the display also at 30mm above the PC board.

Drill a hole in the box lid for the sensor and make the rectangular slot for the LED display using a series of holes along the required area, filed to shape. Also drill out a hole in the side of the box suitable for the wiring entry to the power screw connector.

We used a length of figure-8 wire and a cigarette lighter plug to supply power. Alternatively, a DC line socket could be mounted on the side of the case and either a plugpack (for mains operation) or a power lead fitted with a matching DC plug could be used to connect to a source of 12V DC.

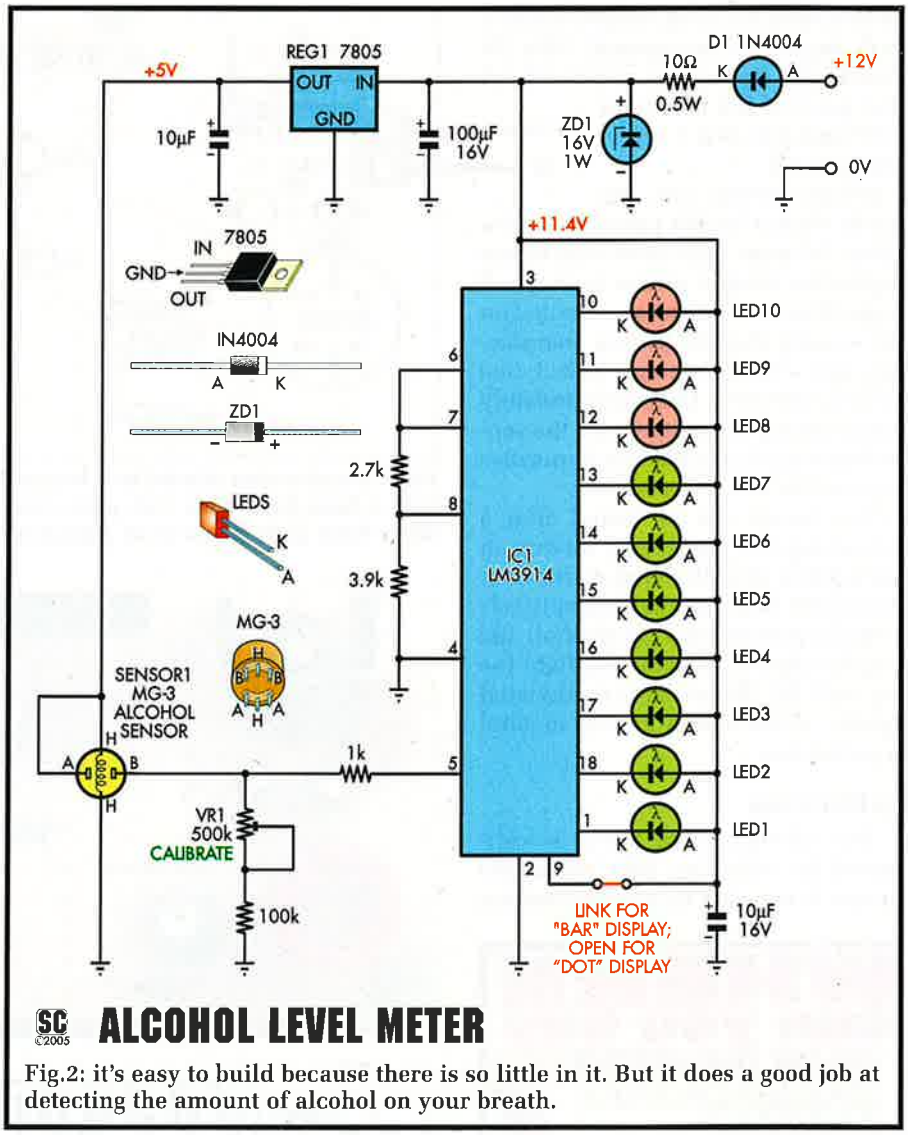


Fig.2: it's easy to build because there is so little in it. But it does a good job at detecting the amount of alcohol on your breath.

Testing

Connect power to the Alcohol Level Meter and adjust VR1 so that all the LEDs light up. If you cannot see the LEDs light, check that the power supply polarity is correct. You

BAC versus weight for WOMEN

No. of drinks in one hour	Weight 45kg	55kg	65kg	75kg	80kg	90kg.	100kg	110kg
1	.05	.04	.04	.03	.03	.03	.02	.02
2	.10	.08	.07	.06	.06	.05	.05	.04
3	.15	.13	.11	.10	.08	.08	.07	.06
4	.20	.17	.15	.13	.11	.10	.09	.09
5	.25	.21	.18	.16	.14	.13	.12	.11
6	.30	.26	.22	.19	.17	.15	.14	.13
7	.36	.30	.26	.22	.20	.18	.16	.15
8	.41	.33	.29	.26	.23	.20	.19	.17
9	.46	.38	.33	.29	.26	.23	.21	.19
10	.51	.42	.36	.32	.28	.25	.23	.21
11	.56	.46	.40	.35	.31	.27	.25	.23
12	.61	.50	.43	.37	.33	.30	.28	.25
13	.66	.55	.47	.40	.36	.32	.30	.27
14	.71	.59	.51	.43	.39	.35	.32	.29
15	.76	.63	.55	.46	.42	.37	.35	.32

BAC versus weight for MEN

No. of drinks in one hour	Weight 45kg	55kg	65kg	75kg	80kg	90kg	100kg	110kg
1	.04	.04	.03	.03	.02	.02	.02	.02
2	.09	.07	.06	.05	.05	.04	.04	.04
3	.13	.11	.09	.08	.07	.07	.06	.05
4	.17	.15	.13	.11	.10	.09	.08	.07
5	.22	.18	.16	.14	.12	.11	.10	.09
6	.26	.22	.19	.16	.15	.13	.12	.11
7	.30	.25	.22	.19	.17	.15	.14	.13
8	.35	.29	.25	.22	.19	.17	.16	.14
9	.37	.32	.26	.24	.20	.19	.17	.15
10	.39	.35	.28	.25	.22	.20	.18	.16
11	.48	.40	.34	.30	.26	.24	.22	.20
12	.53	.43	.37	.32	.29	.26	.24	.21
13	.57	.47	.40	.35	.31	.29	.26	.23
14	.62	.50	.43	.37	.34	.31	.28	.25
15	.66	.54	.47	.40	.36	.34	.30	.27

should have 5V at the output of REG1 with respect to the ground. This 5V should also be at pin 3 of IC1. Check that pin 8 of IC1 is around 1.8V and pins 6 & 7 are at around 3.1V.

Before further use, the meter should be left powered up for about 24 hours. This allows the heater inside the alcohol sensor to burn off impurities that may have collected on the sensing element during manufacture and while in storage. In fact, one of the lower green LEDs will probably remain lit for some time until the sensor has purged off sufficient impurities to raise the sensor resistance.

The sensor can be tested after a few minutes of purging by waving an open bottle of methylated spirits over the sensor. Since methylated spirits is virtually pure ethanol (an alcohol), the display should immediately light the top red LED. Never drink methylated spirits, as the added methyl alcohol is poisonous.

Calibration

The Alcohol Level Meter is calibrated by adjusting VR1 when the sensor is exposed to a concentration

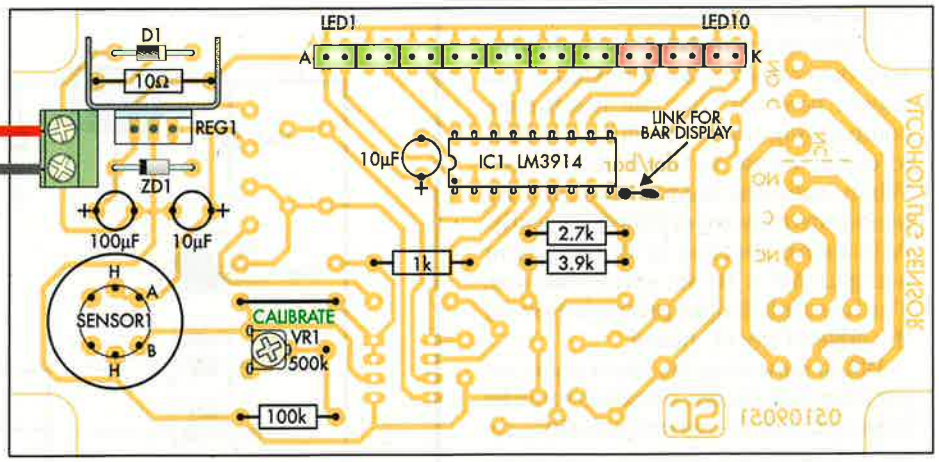
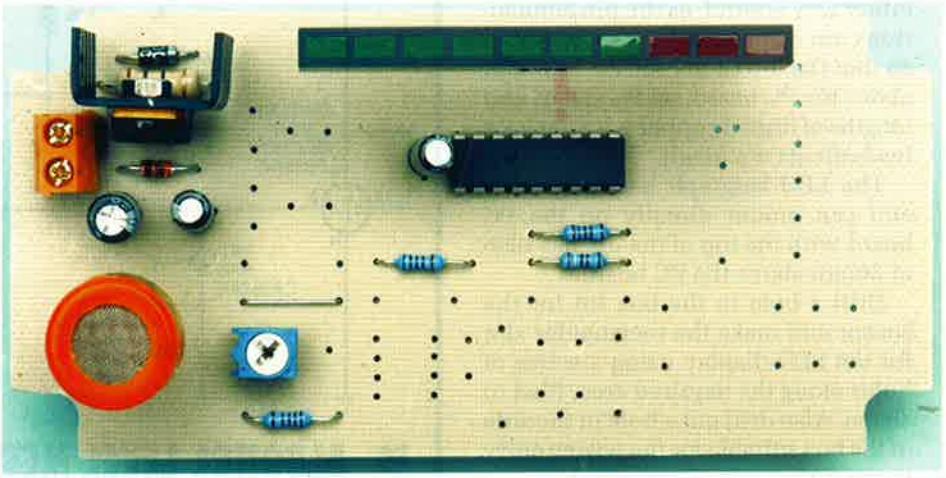


Fig.3: construction should be a breeze with this overlay diagram and the photo below. Note the dot/bar link pads (immediate bottom right of the IC). You should short these pads if you want a bargraph; leave them open for a dot display.



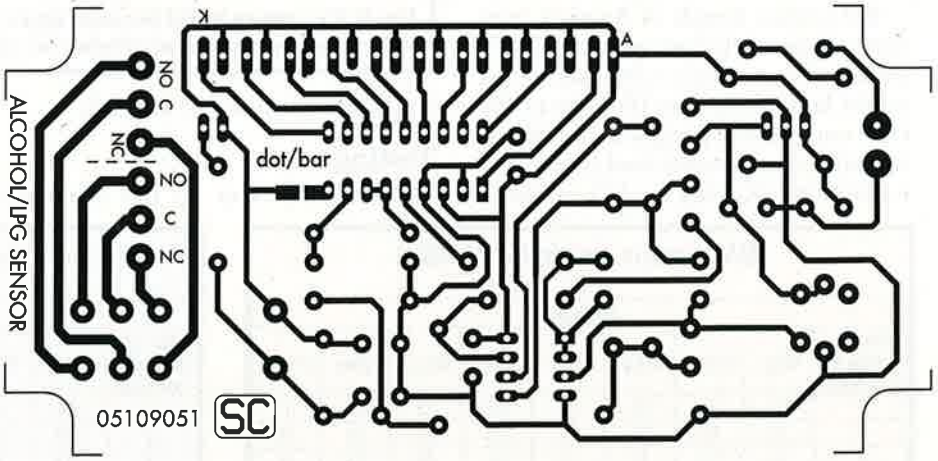


Fig.4: same-size PC board pattern for those who wish to make their own boards.

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You can get your copy of **SILICON CHIP every month from your newsagent**: in most it's on sale on the last Wednesday of the month prior to cover date. You can ask your newsagent to **reserve your copy** for you. If they do not have **SILICON CHIP** or it has run out, ask them to contact Network Distribution Company in your state.

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Resistor Colour Codes

	No.	Value	4-band Code (1%)	5-band Code (1%)
☐	1	100kΩ	brown black yellow brown	brown black black orange brown
☐	1	3.9kΩ	orange white red brown	orange white black brown brown
☐	1	2.7kΩ	red violet red brown	red violet black brown brown
☐	1	1kΩ	brown black red brown	brown black black brown brown
☐	1	10Ω	brown black black brown	brown black black gold brown

Why does it work?

How does measuring the amount of alcohol on the breath determine the amount of alcohol in the bloodstream? It's all tied up with the way the body obtains oxygen from the air in the lungs.

Once drunk (no pun intended), alcohol is absorbed into the bloodstream over the next 15-20 minutes (it actually dissolves in the water of the blood) via the stomach and small intestine – and it is neither digested (ie, like a food) nor chemically changed. The alcohol is carried by the blood and pumped around the body by the heart.

All of this blood must pass through the lungs to be replenished with oxygen.

Here, literally millions of tiny blood-laden vessels, called alveoli, are responsible for grabbing passing oxygen and absorbing it into the bloodstream.

But if there is alcohol in the bloodstream, it is just as happy about going the other way – that is, some passes through the alveoli and evaporates into the air in the lungs. It's not a huge amount (otherwise the lungs would fill up with alcohol!) – the ratio of alcohol on the breath to alcohol in the bloodstream is a relatively constant 2100:1.

But even this tiny amount can be measured and gives a reliable indication of blood alcohol level.

There are many common myths about the ability to "mask" or reduce the alcohol in the breath so that you will not fail a breath analysis.

The popular TV show "Mythbusters" recently busted all of the following wide open – nothing decreased the amount of breath alcohol detected and some actually increased it!

- Fresh breath mints (no effect)
- Mouthwash (increased the reading, probably due to the alcohol it contains)
- Hyperventilation (either no change or increased the reading)
- Placing a battery in the mouth (!) – no change
- Eating a raw onion (no change – except for the breath of the eater!)
- Denture cream (no change)
- Placing copper coins in the mouth (dare we say it – no change for small change!)

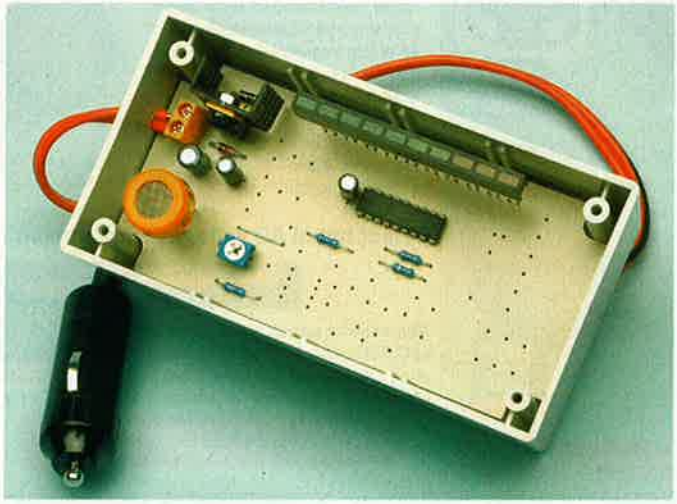
You might like to check some of these out (and other "sure-fire" methods you might hear about) with your own SILICON CHIP Alcohol Level Meter (not too sure about the battery or coins in the mouth, though . . .)

of alcohol in air. Calibration is not accurate and we suggest you read the accompanying warning panel.

You can calibrate the meter by drinking "standard drinks" as shown in the accompanying tables. You will need to drink sufficient standard drinks in one hour in order to raise the blood alcohol level to 0.05% or close to it. For example if you are an 80kg man then you will need to drink two standard drinks in an hour to raise your blood alcohol level to 0.05%.

A standard drink includes a middy (385ml) of full-strength beer or a 200ml nip of spirits. You should wait about 15 minutes after the hour's drinking to ensure the alcohol has entered the bloodstream. By this time, the alcohol will also be present on your breath. Blow into the alcohol sensor and adjust VR1 so that the red LED just lights. This calibrates approximately to the 0.05% level. However, actual levels really depend on many factors including how much food is also present in the stomach at the time of drinking. It is also true that this level of alcohol will have vastly different effects between individuals.

Blood Alcohol Level (or BAL) (also known as Blood Alcohol Concentration, BAC) is the amount of alcohol present in the blood and is calculated by determining how many milligrams of alcohol are present in 100ml of blood. The tables earlier in this article show the expected BAL from a person who metabolises or breaks down one standard drink per hour. **SC**



The assembled PC board mounts in the box by clicking it into the indents in the vertical guides, moulded in the sides of the case. This puts the PC board 30mm below the case lid height – co-incidentally the same height we mount both the alcohol sensor and the LEDs.

Parts List – Alcohol Level Meter

1 PC board coded 05090051, 123 x 60mm
1 UB3 box, 130 x 67 x 44mm
1 MQ-3 alcohol fume sensor (Jaycar RS-5605) (Sensor 1)
1 cigarette lighter plug
1 mini heatsink, 19 x 19 x 10mm
1 2-way PC mount screw terminal block
1 M3 x 10mm screw and nut
6 PC stakes
1 200mm length of light-duty figure-8 polarised wire
1 150mm length of 0.8mm tinned copper wire

Semiconductors
1 LM3914 10-LED bargraph display driver (IC1)
1 7805 5V regulator (REG1)
1 10-LED bargraph (LED1-LED10)
1 1N4004 1A diode (D1)
1 16V 1W zener diode (ZD1)

Capacitors
1 100µF 16V electrolytic
2 10µF 16V electrolytic

Resistors (0.25W, 1%)
1 100kΩ 1 3.9kΩ
1 2.7kΩ 1 1kΩ
1 10Ω 1/2W
1 500kΩ horizontal trimpot (code 504) (VR1)

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Combines the functionality of many high tech pieces of equipment in one compact hand held device. It incorporates a 5MHz digital storage oscilloscope, true RMS autoranging multimeter, logic analyser, frequency & function generator. All measurements can be printed to an external thermal printer via the inbuilt RS232 port. **Supplied complete with test leads, rechargeable battery pack, scope probe, temperature probe, AC adaptor, carry case and holster.** **Specs:** • 5MHz bandwidth • 25ms sampling rate • Dual mode voltage & wave shape display • 1.3GHz frequency generator • True RMS AC voltage to 700V @ 20A • DC voltage to 1000V @ 20A • Temperature to 1200°C • Easy menu driven operation • *See website for more info!*

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With standard VESA mounting dimensions

These handy wall mount LCD brackets allow you to reclaim your desk space & allow greater adjustability than most standard monitor brackets. Available in extendible and fixed types. Great for the study, kitchen, bedroom, theatre etc.

$65 H 8181

Finished with industrial grade high gloss powdercoating.

$34.95 H 8180

Precision benchtop multimeter

Great for the workbench or service department. Featuring a jumbo backlit display for easy reading, this feature packed precision multimeter provides true RMS measurement, datalogging, USB/serial PC interface and much more! 240V or battery powered (6 x C Cells). • 10A AC/DC • Frequency to 50MHz • Software, temp probe, PC interface leads included

$349 Q 1520 NEW!

Replace up to 6 remote controls with just ONE!

Coffee table covered in remotes again? Tired of juggling a handful of remotes just to watch a movie? The A 0984 combines the functions of up to 6 of your current remotes into one! Incredibly easy to set up for your system with easy pre-programmed codes or infra-red learning function. **A professional grade remote control for the entry level home theatre system.**

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With stylish blue backlit LCD screen!

BIG 7" SCREEN! **LCD Television for your car, caravan or boat!**

A fantastic addition to your mobile audio visual system. The 7" wide format LCD screen will amaze you with its clarity and sharpness. It will display TV stations via an inbuilt tuner or accept an AV input from DVD or VHS, even camcorders. • Supplied with adjustable mounting bracket & remote control • Runs off 12V, easy to setup and install! • Slimline design

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Monitor your circulatory health at home!

NEW MODEL!

With jumbo 'easy-read' display & arm band. Measures your systolic/diastolic pressures and heart rate. Provides a simple way to get fast and accurate blood pressure readings. Stores 30 readings for up to 3 individuals. Monitor your health at home with ease.

$119 X 4002

Pocket Audio Signal Generator

A must have piece of test equipment for technicians, mobile installers, engineers etc. This highly useful compact tester generates sine and square waveforms in 46 preset frequencies from 20Hz to 150kHz in two ranges (x1 and x100). Crammed with features for the professional and enthusiast alike. Includes test leads and oscilloscope sync output.

$99 Q 1542 RRP $109.95

Extend the range of your remote control!

This stylish unit relays the signal from your remote back to your hi-fi so you can sit around the BBQ this summer with the full power of your hi-fi at your fingertips! Range up to 100m line of sight. 30m through walls.

$55 A 0975 RRP $69.95

Keep your pool or fish tank balanced

Easy-check PH Meter

Why mess around with chemical testers or inaccurate litmus paper? This compact pH meter provides an instant read-out of water conditions without fuss! Great for pool or fish tank owners. pH neutral buffering solution included.

$75 Q 1295 NEW!

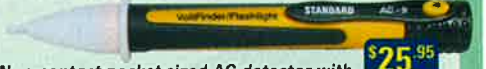
High accuracy pocket scales

Designed for measuring and counting lightweight items. Measures in grams, ounces, troy ounces & pennyweight. 0.1g resolution. 500g max weight.

$89.95 T 2260 NEW!

Great for counting tiny components!

Detect lethal AC voltages without contact



Non-contact pocket sized AC detector with LED flashlight. An essential for anyone operating with AC wiring or transformers. Lights up whenever it is near any AC voltage (100-600V @ 50-60Hz).

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A must have tool for electrical tradespeople or enthusiasts building mains powered kits.

Add extra AV inputs to your TV

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$19.95 A 3058S

BONUS! **1m AV lead (P 6320) valued at $7.30**

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with audio.

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Save a fortune on cabling costs!

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$179 S 5136 RRP $249

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Pays for itself in no time! Suits NiCad or NiMH type batteries. Approx 7 hour charge time. Charges 2 or 4 AA batteries at a time.

$18.75 A 0285

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Great for security, solar power systems, UPS, comms gear etc.

SAVE UP TO 24%

$20ea S 5080 3Ah RRP $24.95

$28ea S 5090B 7.2Ah RRP $36.50

$35ea S 5098 12Ah RRP $42

6 Amp Solar Charge Controller

Great for portable power systems on 4WDs, caravans etc.

Suits wet or dry cell batteries. 6A charging current. Dipped in an epoxy resin allowing it to be utilised in damp or humid areas.

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Charge car or SLA batteries FREE from the sun

Or incorporate renewable solar energy into a home project!

NEW!

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Produces a powerful jet like flame! Great for camping, hiking or even as a cigar lighter!

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Massive 57mm high digit. Common cathode, red illumination.

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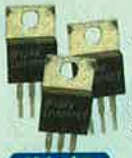
$24 Z 1390 12AX7

$35 Z 1392 EL34

$39 Z 1394 6L6



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With a full range of tips plus extension bar!

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Handy ratchet action speeds up any job!
Designed for a wide variety of electronic devices such as comms equipment, computers, mobile phones and more! Includes 3 phillips, 2 hex nut drivers, 3 flat blade & 4 star bits.

The ultimate tool case
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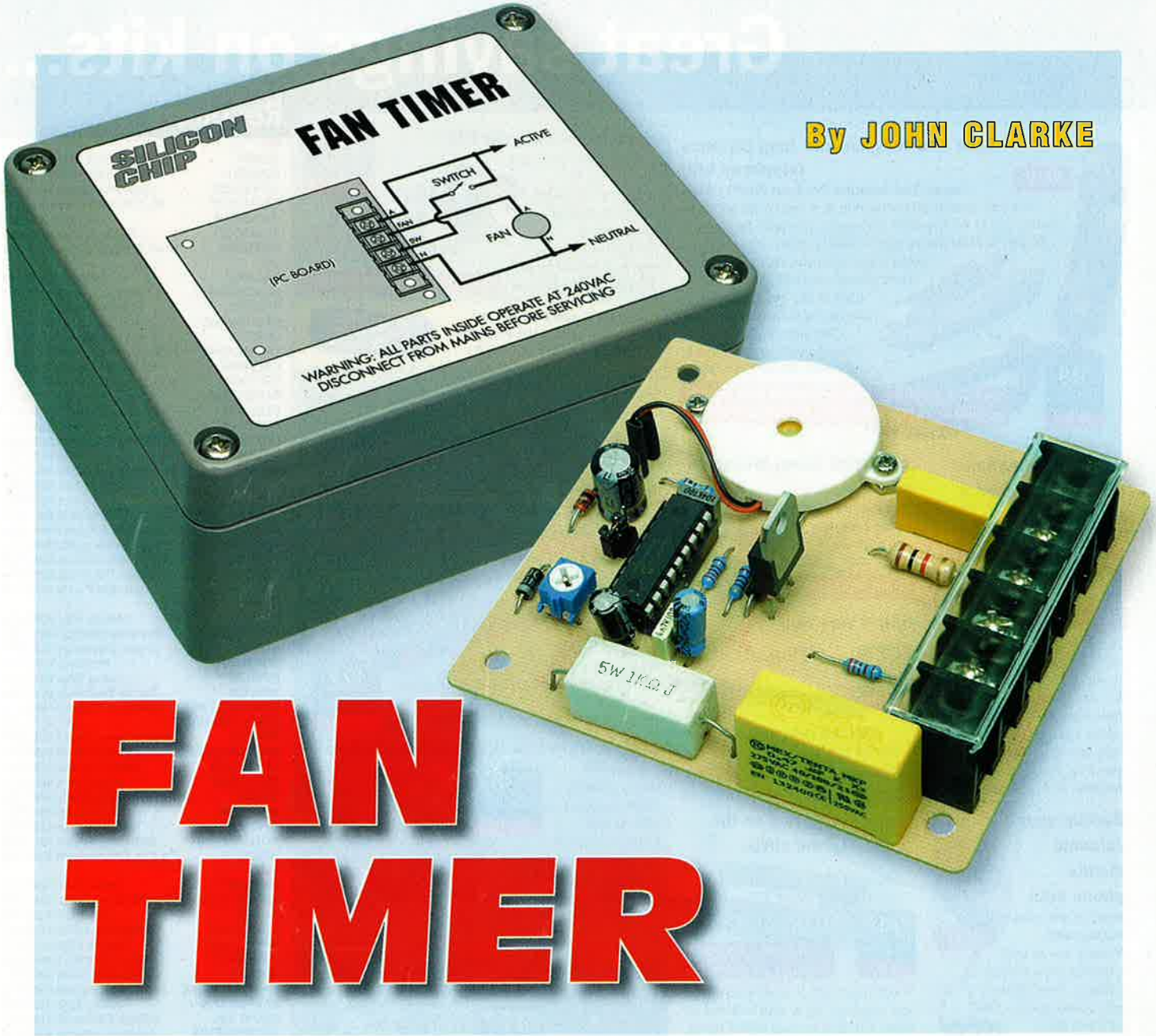

FAN TIMER

By JOHN CLARKE

This Timer can run the fan in your bathroom or toilet for a fixed time after you turn it on. This avoids having the fan run for hours if you forget to turn it off. You can build it to operate in one of two modes – immediate or delayed.

UNLESS YOU CAN KEEP your windows open all the time, you really do need ceiling exhaust fans in your toilet and bathroom to clear steam and odours. Good ventilation stops mould growing on the ceilings and walls and minimises water condensation on the walls and windows if you are having a long, hot shower.

This Fan Timer is housed in a plastic box which is installed near the fan, usually in the ceiling. When you build it, you can set the Timer for one of two modes of operation which we have called "immediate" and "delayed" modes.

In the "delayed" mode, you switch the fan in the normal way using the wall switch. The fan then runs for as long as the switch is left on. When you flip the wall switch off, the fan will then run for a preset period before it switches off automatically.

In the "immediate" mode, the fan is also switched on using the wall switch but in this case, the fan will then run for a preset period before it switches off automatically. If you need to run it for a longer time, you flip the switch to its other position to make the fan run for the same preset period. Alternatively, you can extend the fan running time by the same preset period, by flipping the wall switch to its other position before the fan stops. If you do this, the fan timer will acknowledge the time extension by giving a short beep.

In fact, you can do this twice, to run the fan for three times the normal preset period. Switching a third time turns the fan off.

Each mode has its advantages. The "immediate" mode has the advantage that the fan switch does not need to be manually switched off. This mode is ideal for a household with children!

The "delayed" mode is more suited to people who want to run the fan as long as they are in the bathroom or toilet and who always remember to manually switch off the fan when they leave (letting it run for the preset time). Our choice would be to use the "immediate" mode – that way you don't have to remember to switch off!

The preset running period can be selected from 20 seconds up to 22 minutes. Depending on the room and size of the exhaust fan, a setting of around 5-10 minutes would usually be selected.

Switch wiring

Fig.1 shows the way the Fan Timer connects to the fan and switch. Fig.1(a) shows the normal fan wiring. The Neutral is permanently connected to one of the fan terminals while the Active side of the fan connects to the switch.

Fig.1(b) shows the wiring when the Fan Timer is installed, interposed between the mains Active and the fan. Note that the Fan Timer also requires Active and Neutral power connections.

Note that the fan switching in your home might be more complex, depending on whether the fan is wired in parallel with ceiling lights or is separately switched. The fan might also be part of a fan/heat/light setup like an IXLTastic or similar brand.

Which ever fan/light setup you have, the Fan Timer is installed in the ceiling cavity and you will need the services of a licensed electrician to legally make the connections.

As shown in the photos, the Fan Timer is housed in a small plastic box and it incorporates screw terminals to allow the 240VAC mains connections to be made.

Circuit description

Fig.2 shows the Fan Timer circuit which is based on a PIC16F88 microcontroller (IC1) and a sensitive-gate Triac. There is not much else: several diodes, a piezo transducer and a few resistors and capacitors. The microcontroller senses the selected mode and the setting of the wall switch, operates the piezo transducer and drives the Triac gate for the preset time.

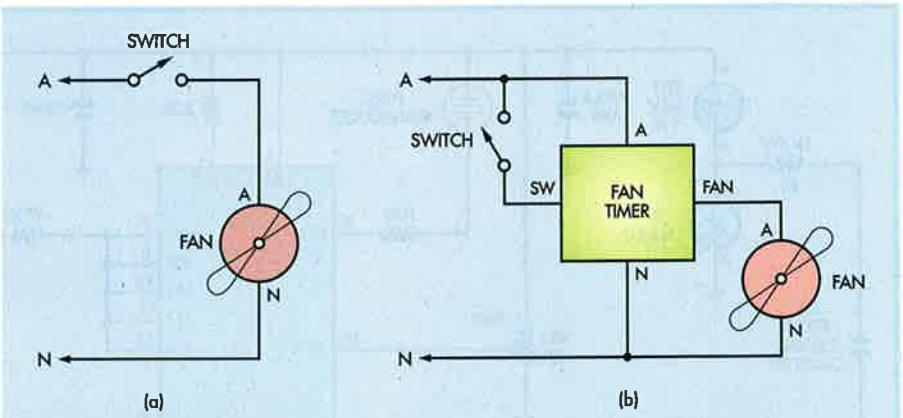

Fig.1(a) at left shows how the fan is normally connected, which Fig.1(b) shows how the Fan Timer is interposed between mains Active and the fan.

Before discussing the circuit of Fig.2, we need to demonstrate how we derive the 5V supply to power the timer circuitry. We have shown this in simplified form in Fig.3. In effect, we need to produce a 5V rail capable of powering the PIC microcontroller and delivering several milliamps gate current to the Triac.

Since we only need a few milliamps of DC, we can derive this directly from the 240VAC mains via the relatively high reactance of a 470nF capacitor (C1) combined with a 1kΩ 5W resistor (R1). This means that there is very low power dissipated in the timer box.

The circuit works as follows. For positive half-cycles of the 240VAC mains voltage, a current i_1 flows from the Active through the 470µF capacitor, diode D1, resistor R1 and capacitor C1. For negative half-cycles of the 240VAC, a reverse current i_2 flows via C1, R1 and zener diode ZD1.

So successive positive half-cycles charge up the 470µF capacitor until its voltage is limited by the 5.6V zener diode ZD1. Subtract the 0.6V voltage drop of diode D1 and this results in a supply voltage to the timer of 5V.

Note that the zener diode works in two modes: limiting the voltage across the 470µF capacitor for posi-

WARNING!

This circuit is directly connected to the mains and all parts operate at 240VAC. As such, contact with ANY part of the circuit could result in serious injury or even death!

DO NOT operate this circuit unless it is fully enclosed in the specified ABS plastic case and DO NOT touch any part of the circuit while it is connected to the mains.

A licensed electrician must be used to connect this unit to fixed electrical wiring.

Main Features

- Fan runs for preset time period
- Connects to standard fan wiring using original switch
- Adjustable time period from 20 seconds to 22 minutes
- Immediate timer start or delayed timer start (selected by single on-board jumper link)
- Up to three times period extension using immediate timer mode
- Piezo sound indication for switch on and period extension

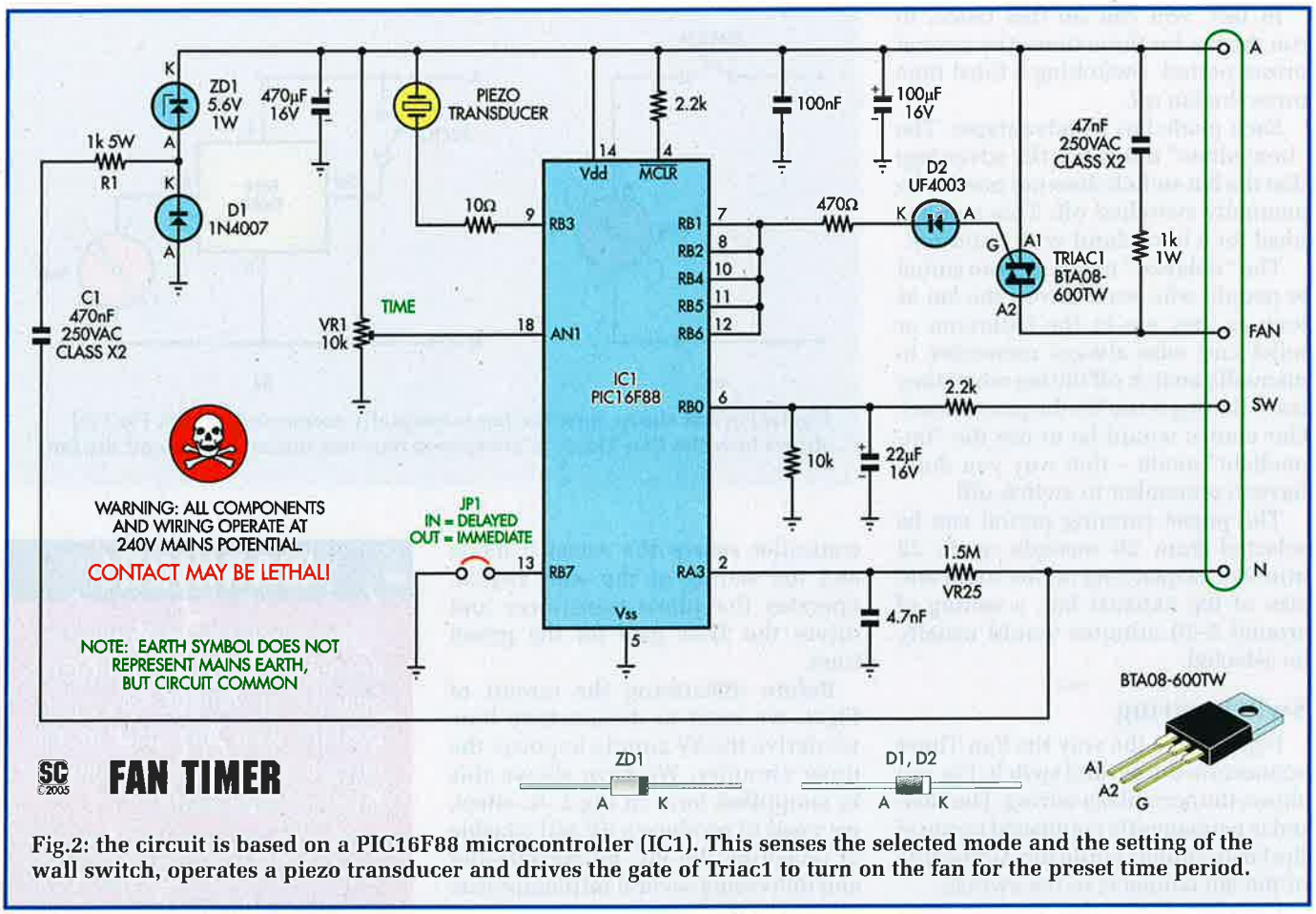

Fig.2: the circuit is based on a PIC16F88 microcontroller (IC1). This senses the selected mode and the setting of the wall switch, operates a piezo transducer and drives the gate of Triac1 to turn on the fan for the preset time period.

tive half-cycles and conducting as a conventional diode for negative half-cycles. **The derived 5V DC supply is tied to the mains Active; ie, it floats at 240VAC and so is hazardous!**

Now that we know how the circuit is powered, it is somewhat easier to see how it works – see Fig.2. Microcontroller IC1 does all the work, sensing when the wall switch is operated, driving the gate of the Triac to turn it on, driving the piezo transducer to produce an audible beep (as mentioned above) and a few other functions which we will get to shortly.

Most of the time, IC1 is in sleep mode, waiting for a signal from its interrupt input at pin 6 (port RB0). The wall switch provides that signal via a 2.2kΩ resistor, with the 22µF capacitor providing filtering to "debounce" the switch signal and also make it less sensitive to any interference signals picked up by the switch wiring.

Normally, pin 6 is pulled low by its associated 10kΩ resistor. However, when the wall switch is closed, to turn on the fan, it pulls pin 6 high to +5V (actually to the 240VAC Active line). This causes the microcontroller to wake up and begins its timing function for the fan.

After the preset time, the microcontroller reverts to sleep mode, waiting for the next throw of the switch.

Five outputs of IC1 (ports RB1-RB6) are paralleled to drive the gate of Triac1 via a 470Ω resistor and fast diode D2. The resistor limits the gate current to around 7mA when the five port outputs go low to pull current out of the gate of the Triac to turn it on to run the fan.

A snubber network comprising a 47nF 250VAC capacitor and 1kΩ 1W

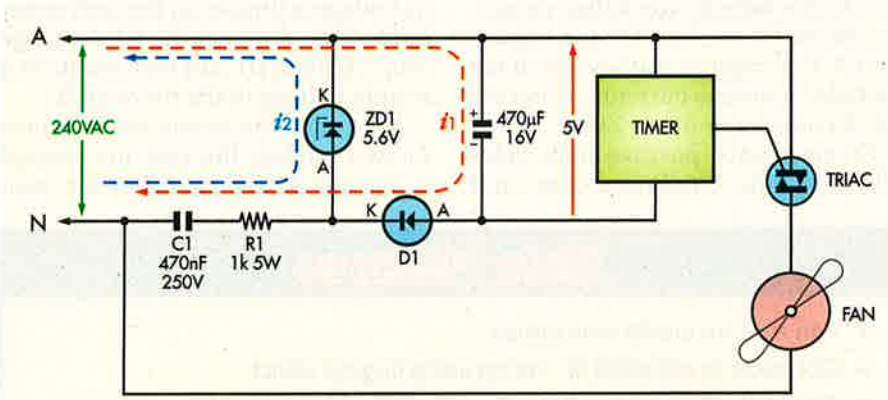

Fig.3: here's how the 5V DC rail is derived for the timer circuitry. The dashed lines (i_1 and i_2) indicate the direction of current flow on alternate half cycles, with successive positive half-cycles charging the 470µF capacitor. The voltage across this capacitor is limited to 5.6V by ZD1. Subtract the 0.6V across D1 and you get 5V DC. Note that this 5V DC rail "floats" at 240VAC.

Parts List

1 PC board, code 10110051, 89 x 81mm
1 sealed IP65 ABS box, 115 x 90 x 55mm (Jaycar Cat. HB-6126)
1 4-way PC-mount terminal barrier with cover, 9.5mm pitch (Jaycar Cat. HM-3162)
1 low-profile piezo transducer (Jaycar Cat. AB-3440)
4 M4 x 10mm screws
2 M4 x 15mm screws
2 M2 x 10mm screws
6 M2 nuts
1 2-way pin header (2.54mm)
1 jumper shunt (JP1)
2 PC stakes
1 25mm length of 0.8mm tinned copper wire
1 10kΩ (code 103) horizontal trimpot (VR1)

Semiconductors
1 PIC16F88 microcontroller programmed with fantimer.hex (IC1)
1 BTA08-600TW 8A 600V 5mA logic drive Triac (TRIAC1) – do not substitute
1 5.6V 1W zener diode (ZD1)
1 1N4007 1A 1000V diode (D1)
1 UF4003 fast recovery diode (D2)

Capacitors
1 470µF 16V PC electrolytic
1 100µF 16V PC electrolytic
1 22µF 16V PC electrolytic
1 470nF 250VAC class X2 metallised polyester
1 100nF MKT polyester
1 47nF 250VAC class X2 metallised polyester
1 4.7nF MKT polyester

Resistors (0.25W, 1%)
1 1.5MΩ VR25 (ie, high voltage – do not substitute)
1 10kΩ
2 2.2kΩ
1 1kΩ 5W, 5%
1 1kΩ 1W, 5%
1 470Ω
1 10Ω

resistor is connected across the Triac to damp any voltage spikes from the fan motor that may damage the Triac. Incidentally, the specified BTA08-600TW Triac is listed as a "snubberless" type, which means that it supposedly does not require an external snubber network. However, we have included the components anyway, to be sure that it can handle a wide range of AC fan motors.

The Triac is also referred to as a "logic level" type but this is not because it requires a 5V logic signal to turn on (like a logic-level Mosfet) but because its low 5mA gate current means that it can be easily turned on by logic circuitry.

This circuit does not use a crystal oscillator but instead relies on an internal oscillator inside IC1, running at about 4MHz. The 1.5MΩ resistor and 4.7nF capacitor at pin 2 of IC1 allow the microcontroller to detect the phase of the mains waveform, so the fan can be switched on and off at the zero crossing point of the 240VAC sinewave. Note that the 1.5MΩ resistor is a Philips VR25 high-voltage type, specified because it has the full mains voltage applied to it at all times.

Pin 4 is a brownout input. Should the supply drop below about 4V, the IC will be held reset until the voltage rises back above 4V. This brownout reset ensures that the microcontroller will operate correctly after any brownout condition has ended.

Linking options

Pin 13 (RB7) selects the delayed or immediate mode of operation, depending on whether a link is connected (delayed mode) or omitted (immediate mode). When the microcontroller is reset or first powered up, the RB7 input is pulled high via an internal pull-up resistor and it checks to see if the pin is high or pulled low via the link. Once it "knows" the answer, the internal pull-up resistor is deselected and no current flows through the link (if present).

Pin 9 (port RB3) drives the piezo transducer via a 10Ω limiting resistor. The transducer is driven with a square wave at around 2kHz to produce an

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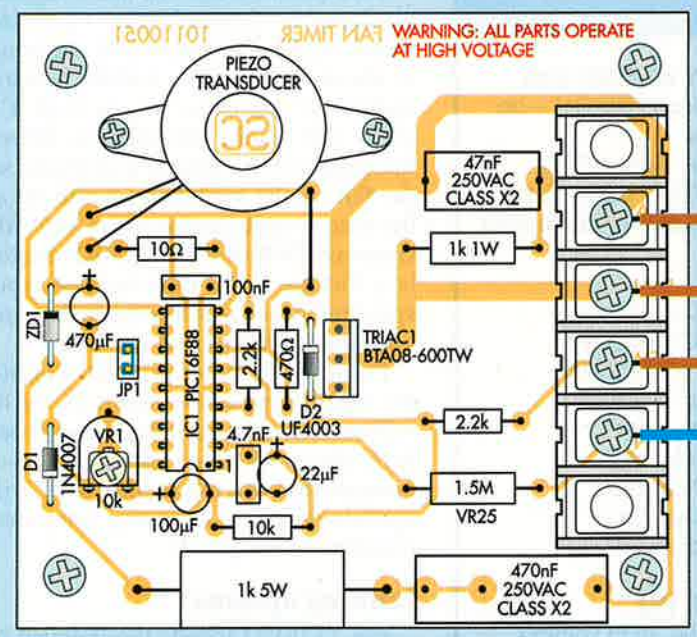
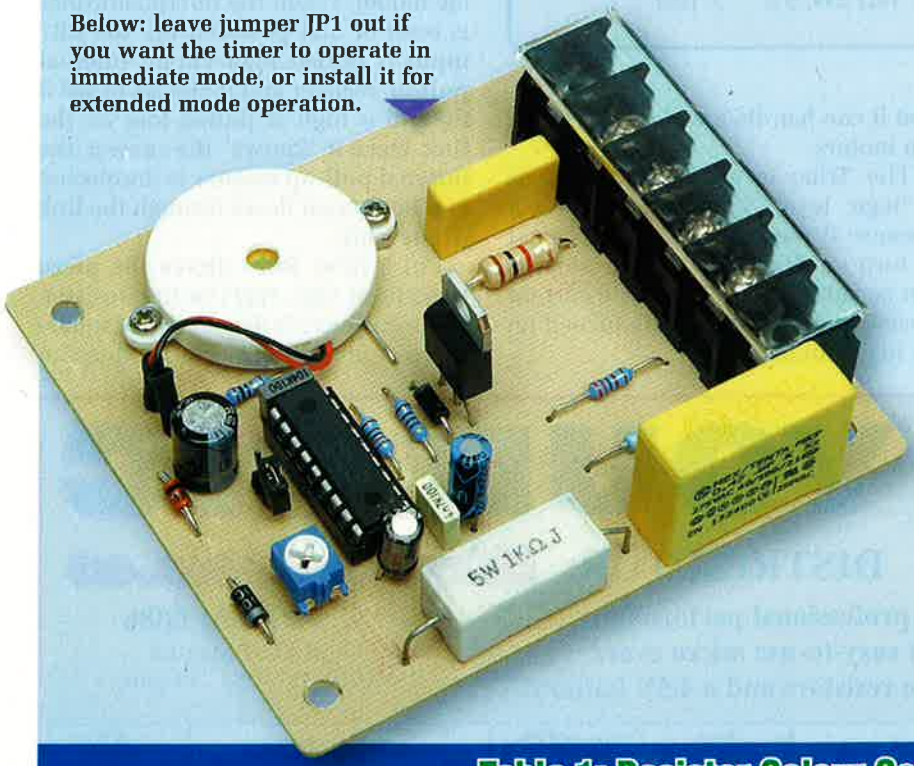


Fig.4 (above): follow this parts layout diagram to build the PC board. Take care with component orientation and note that the 1kΩ 5W resistor should be mounted slightly proud of the board to aid cooling.

Below: leave jumper JP1 out if you want the timer to operate in immediate mode, or install it for extended mode operation.



audible beep when the timing period is increased.

Finally, there is the question of selecting the preset times for the fan to run. Trimpot VR1 is connected across the 5V supply rail and its wiper can be set to provide between 0V and 5V to pin 18 (AN1). This input monitors the voltage and an internal analog-to-digital (A/D) converter produces a digital value which determines the preset timing period.

Fig.5 shows the expected delay times for different settings of VR1.

Construction

Before starting construction, be sure to read the warning panel at the start of this article. **All parts of this circuit operate at 240VAC and are potentially lethal if accidentally touched while it is connected to the mains.**

The Fan Timer is built on a PC board coded 10110051 and measuring 89 x 81mm. Fig.4 shows the parts layout.

Begin by checking the PC board against the published pattern to ensure there are no shorts between tracks or breaks in the copper. That done, install two PC stakes to accept the piezo transducer connections, then install the 2-way header for jumper plug JP1.

Follow these with the wire link and the resistors. Table 1 shows the resistor colour codes but you should also use a multimeter to check the values, as some of the colours can be difficult to decipher. Note that the 1.5MΩ resistor must be a VR25 high-voltage type (do NOT substitute).

Table 2: Capacitor Codes

Value	µF Code	IEC Code	EIA Code
470nF	0.47µF	470n	474
100nF	0.1µF	100n	104
47nF	.047µF	47n	473
4.7nF	.0047µF	4n7	472

Table 1: Resistor Colour Codes

❑	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	1	1.5MΩ (VR25)	brown green green yellow	NA
❑	1	10kΩ	brown black orange brown	brown black black red brown
❑	2	2.2kΩ	red red red brown	red red black brown brown
❑	1	1kΩ 5%	brown black red gold	NA
❑	1	470Ω	yellow violet brown brown	yellow violet black black brown
❑	1	10Ω	brown black black brown	brown black black gold brown

Note also that the 1kΩ 5W resistor should be mounted 3-4mm proud of the PC board to allow the air to circulate beneath it for cooling.

Next, install a socket for IC1, making sure the orientation is correct – the notched end goes towards the 100µF capacitor as shown on Fig.4. That done, the capacitors can be installed but watch the polarity of the electrolytics.

Diodes D1, D2 and ZD1 can go in next, again making sure they are all correctly oriented. Also, be careful not to get D1 and D2 mixed up – D1 is a 1N4007, while D2 must be a UF4003 fast recovery type.

Now for the Triac. This must be installed with its metal tab facing towards the terminal block. Push it as far down onto the PC board as it will comfortably go before soldering its leads. **Note: be sure to use the specified Triac – do not substitute for this part.**

The piezo transducer can go in next. It's secured to the PC board using two M2 screws and six M2 nuts, **with four of these nuts (two on each side) acting as spacers (ie, they go between the transducer and the PC board).** That done, slide some small-diameter heatshrink tubing over the transducer's leads and solder them to the adjacent PC stakes (the polarity isn't important). The heatshrink can then be slid down over the PC stakes and shrunk down to insulate (and strengthen) the connections.

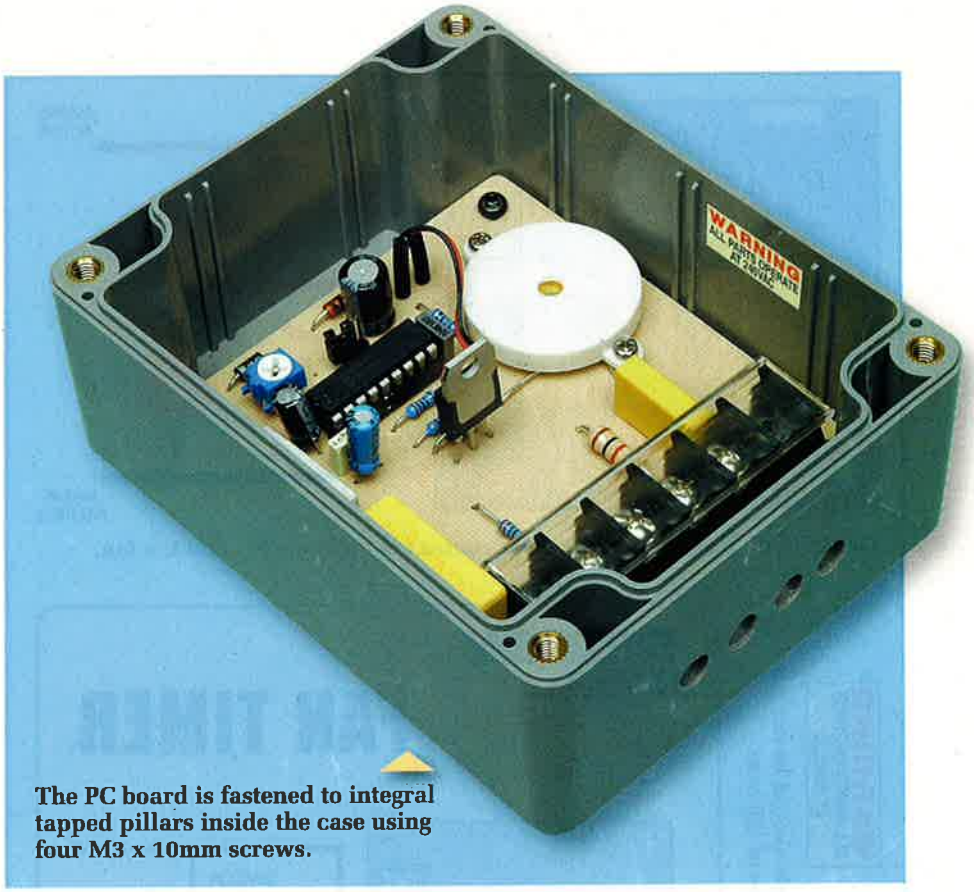
The large shrouded 4-way screw terminal strip is next on the list – just push it all the way down onto the PC board and solder it at the four central points. The two outer mounting points are not used here – ie, leave the mounting screws out.

Finally, finish the PC board assembly by inserting the programmed PIC microcontroller (IC1) into its socket.

Installing it in the case

The completed PC board is housed inside a sealed IP65 ABS plastic box measuring 115 x 90 x 55mm. The specified unit (see parts list) is made of high-impact ABS material and features wall-mounting holes that are fully isolated from the internal compartment.

It also features four integral mounting pillars with threaded brass inserts on the base and the lid-fixing screws also go into threaded brass inserts at the corners.



The PC board is fastened to integral tapped pillars inside the case using four M3 x 10mm screws.

Fig.5: here's how to set trimpot VR1 for various delay time intervals. Note that this trimpot operates at high voltage, so don't attempt to adjust it after the Fan Timer has been connected to the mains unless you use a fully-insulated tool.

Do not substitute for this case, as it's ideally suited to the job. For safety reasons, it's vital that the PC board be fully enclosed inside the case, with no protruding metal parts. Don't even think of using a metal case!

The plastic case will need to be drilled so that there is access for the external wiring to connect to the screw terminals. These holes also allow the sound from the piezo transducer to escape from the box.

Before installing the board, go over your work carefully and check that all parts are in their correct locations and that all polarised parts are oriented correctly. Check also for any short circuits due to solder bridges on the copper side of the PC board.

Once you are sure that everything is correct, the board can be installed in the box. It's simply secured to the four tapped integral pillars using M3 x 10mm screws.

You now have to decide on the time that you want the fan to run for and adjust trimpot VR1 accordingly. Fig.5 shows the expected time periods for several positions of VR1. **Do not attempt to adjust VR1 after the circuit has been connected to the mains, unless you use a fully-insulated tool (the trimpot operates at mains potential).**

You also have to decide on the operating mode that's required. Leave JP1 out if you simply want the fan to run for a set time after if has been turned

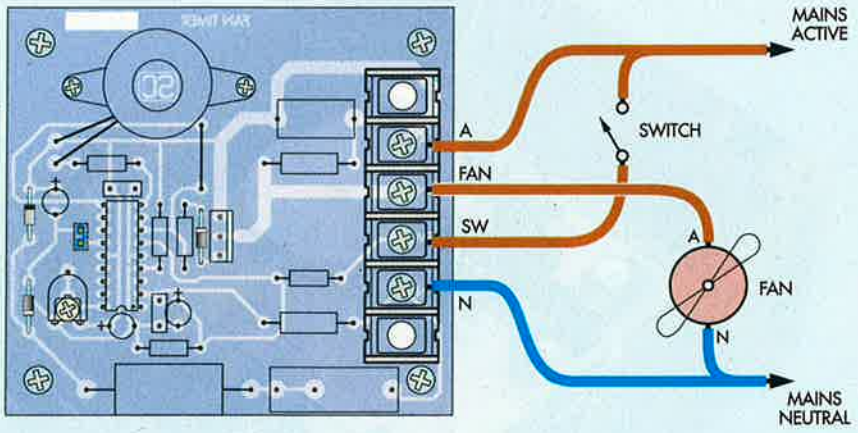


Fig.6: here's how the Fan Timer is connected to the mains and the fan.

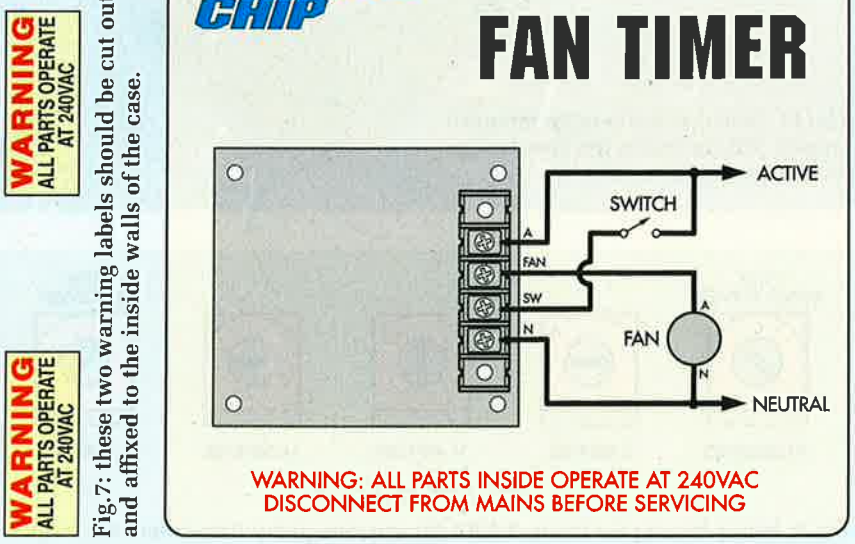


Fig.7: these two warning labels should be cut out and affixed to the inside walls of the case.

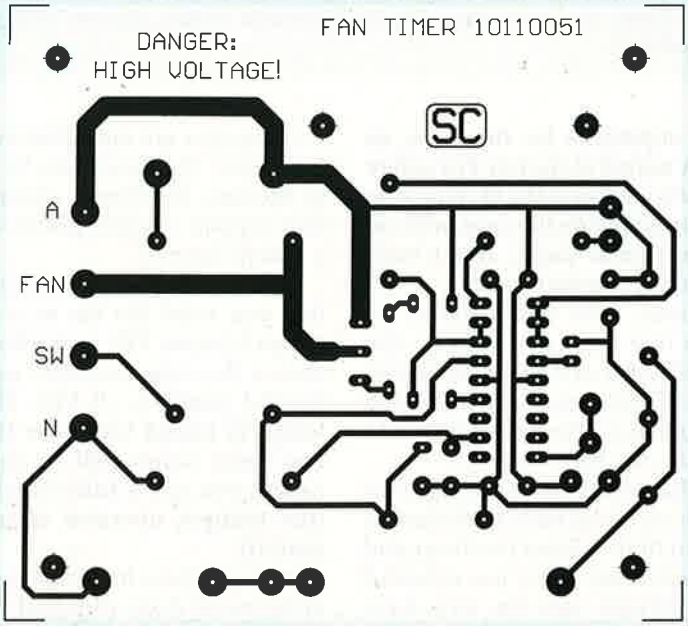


Fig.8: above are the full-size artworks for the front panel & the PC board.

on (this is the "immediate" mode). Alternatively, install jumper JP1 if the want the fan to continue running for a set time after it has been switched off ("delayed" mode).

By the way, don't be tempted to substitute a conventional pot for trimpot VR1. That would be much too dangerous. Remember – it operates at 240VAC.

Finally, the front panel label should be affixed to the case lid, while the two warning panels should be cut out and attached to a couple of inside walls.

Installation

There is no safe way to test the Fan Timer circuit before it is installed – see the warning panel. It really is a matter of installing it and then seeing if it works correctly.

Note that this unit should only be connected to the house wiring by a licensed electrician. Note that the specified box has mounting holes adjacent to the four corner pillars, which means that it can be secured to a timber beam or floor joist using wood screws. These mounting holes are fully isolated from the internal circuitry, so this is safe to do with the specified case.

When the Fan Timer is powered up, the switch will initially have to be "switched over" a couple of times to turn the fan on. This will also have to be done if there has been a power blackout or brownout.

This feature prevents the fan from starting up on its own when power is initially applied to the circuit. Once the fan has been switched on, the switch then acts as normal, according to the timing mode set by JP1.

Dealing with a thermostat

Finally, note that some exhaust fans are incorporated into heater lamp assemblies – eg, the IXLTastic range, as used in bathrooms. In these units, the fan will automatically start and run when the temperature reaches a certain level within the fan enclosure. The switching is done using a thermostat and is necessary to provide cooling inside the housing.

The thermostat switch is connected between mains Active and the fan and will therefore operate in parallel with the Triac of the Fan Timer. This means that the thermostat will override the Fan Timer when closed, with the Fan Timer then operating normally when the thermostat opens. SC

PRODUCT SHOWCASE

OEM Bluetooth from RF Modules

RF Modules Australia has introduced a range of miniature OEM Bluetooth modules, suited to a wide range data link applications.

The Promi-ESD and Promi-ESD-02 OEM Bluetooth modules offer short and medium range, low-power, reliable bi-directional data link communications in a miniature footprint. Their UART interface makes them ideal for embedding in low power applications where connectivity to the new wave of Bluetooth equipped devices is required.

The Promi-ESD-02 Class 2 Bluetooth module, measuring 18 x 20 x 6mm, is equipped with an on-board chip antenna giving an effective range of up to 30 meters, making it ideal for PCB mounting where space is a premium. This module offers low power operation and is suited to battery powered and hand held applications.

The Promi-ESD Class 1 Bluetooth module, measuring 27 x 27 x 6mm, is supplied with an external antenna, cable and connector.

Being a higher power Bluetooth module, it gives an effective range of up to 100m.

Both modules are configured as Bluetooth Serial Port Profile (SPP) devices providing integration into Microsoft Windows XP Bluetooth support.

They can be paired with most modern Pocket PC and Palm devices that support Bluetooth connectivity. The modules are compliant to Bluetooth specification V1.1.

The modules are supported by a separately available development and testing jig, the Promi-DBS, to allow the user to configure and test the modules. The test jig is supplied with a suitable serial adapter cable, configuration software and manuals on CD.

Contact:
RF Modules Australia
PO Box 1957, Launceston, Tas 7250
Tel: (03) 6331 6789 **Fax:** (03) 6331 1243
Website: www.rfmodules.com.au

Jaycar sponsors "Sunsprint" solar car race series

Jaycar Electronics was the major sponsor for the recent "Sunsprint" solar-powered model car races.

Teams of enthusiastic constructors from secondary schools designed and built the "cars" which were then raced against each other on a figure-8 circuit including a very testing (for some!) overpass at the University of New South Wales, shown in our photo at right.

There was also a straight, short course for a "novice" division.

In somewhat overcast conditions for the Sydney event (which were described by organisers as the best conditions for years!) cars completed two laps of the course, if they could – although the shadow under the overpass put paid to some!

Gary Johnston, Managing Director of Jaycar Electronics, said that his company was delighted to support this popular – and growing – event which combined design, electronics and mechanical skills.

The winner of the Sydney event, next to race at the National Finals in Melbourne (also sponsored by Jaycar), was St Pauls Catholic College, Greystanes, with their car no. 5; "Nitrous".

Contact:
Jaycar Electronics
PO Box 6424, Silverwater NSW 1811.
Tel: 1800 022 888 **Fax:** (02) 9741 8500
Website: www.jaycar.com.au

Altronics' new Melbourne store DMM GIVEAWAY

Altronics would like to welcome all Victorian electronics enthusiasts and hobbyists to their new Melbourne store, located in Springvale and opening on October 3rd.

As an enticement they are offering you an excellent digital multimeter **absolutely free** with any purchase (even a 50 cent purchase!). Simply ask for the free multimeter mentioned in SILICON CHIP magazine, October issue. Strictly limited to one per person during October 2005.

This fantastic little 3.5 digit multimeter features 19 ranges including an in-built transistor and diode test function.

This meter provides a surprising number of features and facilities and would be perfect for the budding enthusiast or a spare meter for the toolbox or glovebox.

ONLY at Altronics (Melbourne store)
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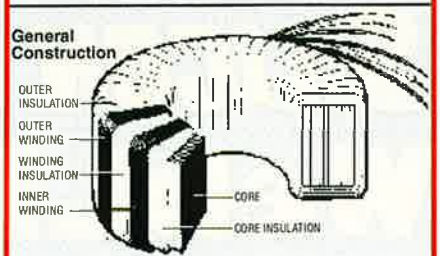

Manufactured in Australia
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9/40 Leighton Pl. HORNSBY 2077
Ph (02) 9476-5854 Fx (02) 9476-3231

USB to USB copies without a PC

With so many USB devices around these days, there are many times you need to copy data from one to another. It's not hard to do – just plug both devices into computer USB ports, wait until they're recognised, and copy.

But what if you don't have a computer handy? This nifty little device from Microgram Computers lets you copy data from USB device to USB device without a PC. You simply choose the source and destination – and start copying!

It's ideal for copying MP3s, software, pictures and general data files from one to another and even checks your destination first to avoid overwriting or duplication. It makes a perfect backup system, supporting USB mass storage devices using FAT12/16/32 file systems.

It sells for $79.00 from Microgram Computers (Cat 3574-13).

Contact:
Microgram Computers
1/14 Bon Mace Cl, Berkeley Vale 2261
Tel: (02) 4389 8444 **Fax:** (02) 4389 8388
Website: www.microgram.com.au

TDK Semiconductor no more!

TDK Semiconductor Corporation, a leader in mixed-signal integrated circuits, has changed it name to Teridian Semiconductor Corporation, effective immediately.

The company's new name comes as they launch a number of new products in the residential and industrial meter, smart card reader, Ethernet, and WAN markets.

The company is working with its customers to facilitate a smooth name change transition.

Contact:
Teridian Semiconductor
6440 Oak Canyon, Irvine Ca 92618-5201
Tel: 0011 1 714 508 8800
Website: www.teridian.com

LCD wall brackets

Altronics have released two new LCD mounting brackets for monitors and televisions. Top is the H8180, which allows both horizontal and vertical adjustment for use in a wide variety of installations. Mounting holes are provided for standard VESA sizes, making them with most LCDs.

Botom is the H8181, similar to the above unity but is more stylish and has an extendable arm.

Contact:
Altronics Distributors
Box 8350, Perth Business Centre 6849
Tel: 1300 797 007 **Fax:** (08) 9428 2187
Website: www.altronics.com.au

DSE's USB-controlled Electrocardiograph kit

Dick Smith Electronics have released their long-awaited kit for the Electrocardiograph, as featured in the February 2005 SILICON CHIP.

The DSE kit has all specified components and hardware ***including*** the USB interface module from Elexol and a pair of ECG pads will also be supplied in the kit to get constructors started. Additional pads (Cat ZA-5743) are available from the kit department and in turn can be ordered from their nearest DSE outlet or from our Direct-Link Mail order centre (Toll Free – Australia Only – Phone 1300 366 644).

A specially designed case has been manufactured for the project. It is fully punched, powder-coated (matte black) and screen printed to give the final project that professional "your friends won't believe you built it" look.

Priced at $139.00, kits will be available from all DSE retail stores (excluding PowerHouses), mail-order and internet sales. (Cat K-3704)

Contact:
Dick Smith Electronics (all stores)
PO Box 500, Regents Park DC NSW 2143.
Tel: 1300 366 644 **Fax:** (02) 9642 9155
Website: www.dse.com.au

SILICON CHIP WebLINK

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Facsimile: (07) 5571 0543

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Homebush NSW 2140
Telephone: (02) 9704 9000
Facsimile: (02) 9746 1197

WEBLINK SC WEBLINK SC WEBLINK SC

Drop it, step on it, scratch it . . .

the iButton is a hard 'nut' to crack!

The iButton family of devices feature silicon chips armoured within 16mm stainless steel cans. Here we describe the basics of these unique devices and then show you how to build a simple PICAXE-based project to read their serial numbers!

By Clive Seager*

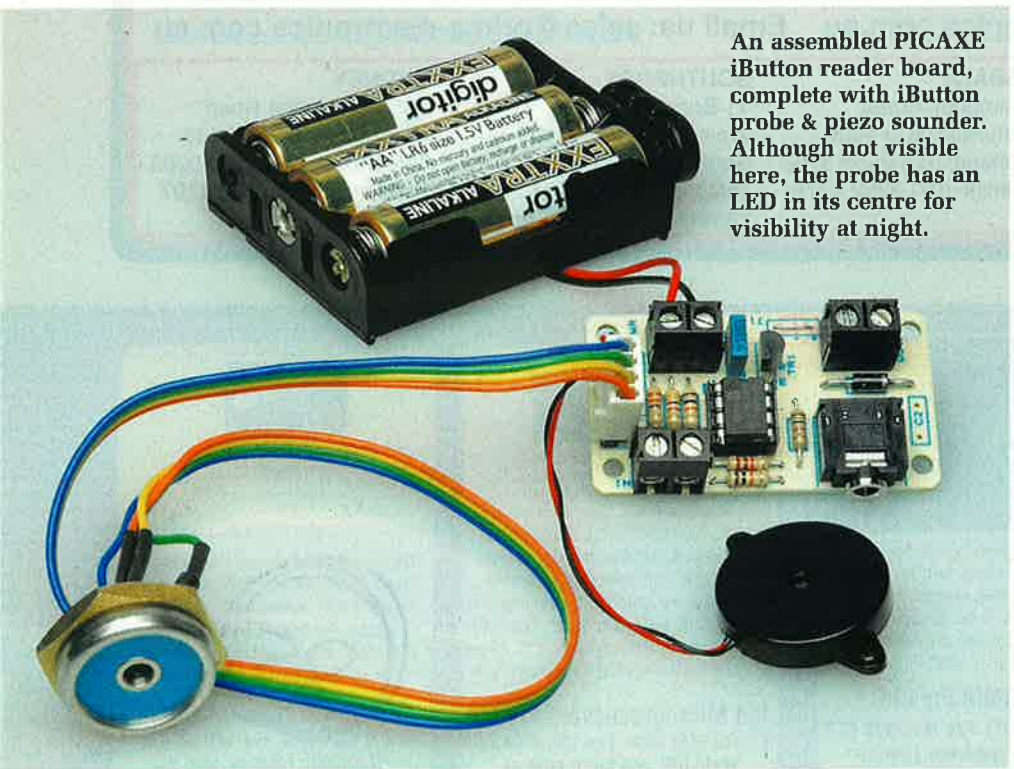
THE iBUTTON FAMILY consists of over 20 different products, including devices that contain memory, temperature sensors, data loggers and even Java computers. Every iButton produced (to date over 100 million) has a unique silicon serial number. This feature makes the iButton ideal for use in automatic identification systems.

In fact, the simplest member of the family, the DS1990A Serial Number iButton, is designed specifically for identification tasks. Like all devices, its 64-bit serial number is guaranteed to be unique and therefore traceable. iButton serial numbers are also laser engraved on the outsides of the cans so that human eyes can read them!

Owing to the small size and robust nature of the iButton package, it can travel with a person or object to provide many useful functions, including access control, environmental monitoring and data storage.

The stainless steel button is durable enough to be worn everyday on an accessory like a ring, key fob, wallet, watch, metal card or badge. It is also water resistant and so can be worn while washing or swimming.

The information in an iButton can be accessed by tapping it against a simple dual-contact metal probe connected to an electronic reader circuit. This type of metal probe is much cheaper and more durable than a magnetic swipe or "smart-card" reader and the iButton itself can have a much larger memory capacity. iButton technology is also cheaper than radio frequency style ID cards (RFID).



An assembled PICAXE iButton reader board, complete with iButton probe & piezo sounder. Although not visible here, the probe has an LED in its centre for visibility at night.

Inside an iButton

The electronics inside an iButton connects to the outside world via the base and lid of the metal can, which are electrically isolated from one another by a polypropylene grommet. When an iButton is momentarily touched against a probe, the side makes a ground connection and the lid (face) makes a power/data connection.

In a fraction of a second, the iButton accumulates sufficient energy from the reader to power its circuits. It then communicates with the reader over the

* About the author: Clive Seager is the Technical Director of Revolution Education Ltd, the developers of the PICAXE system.

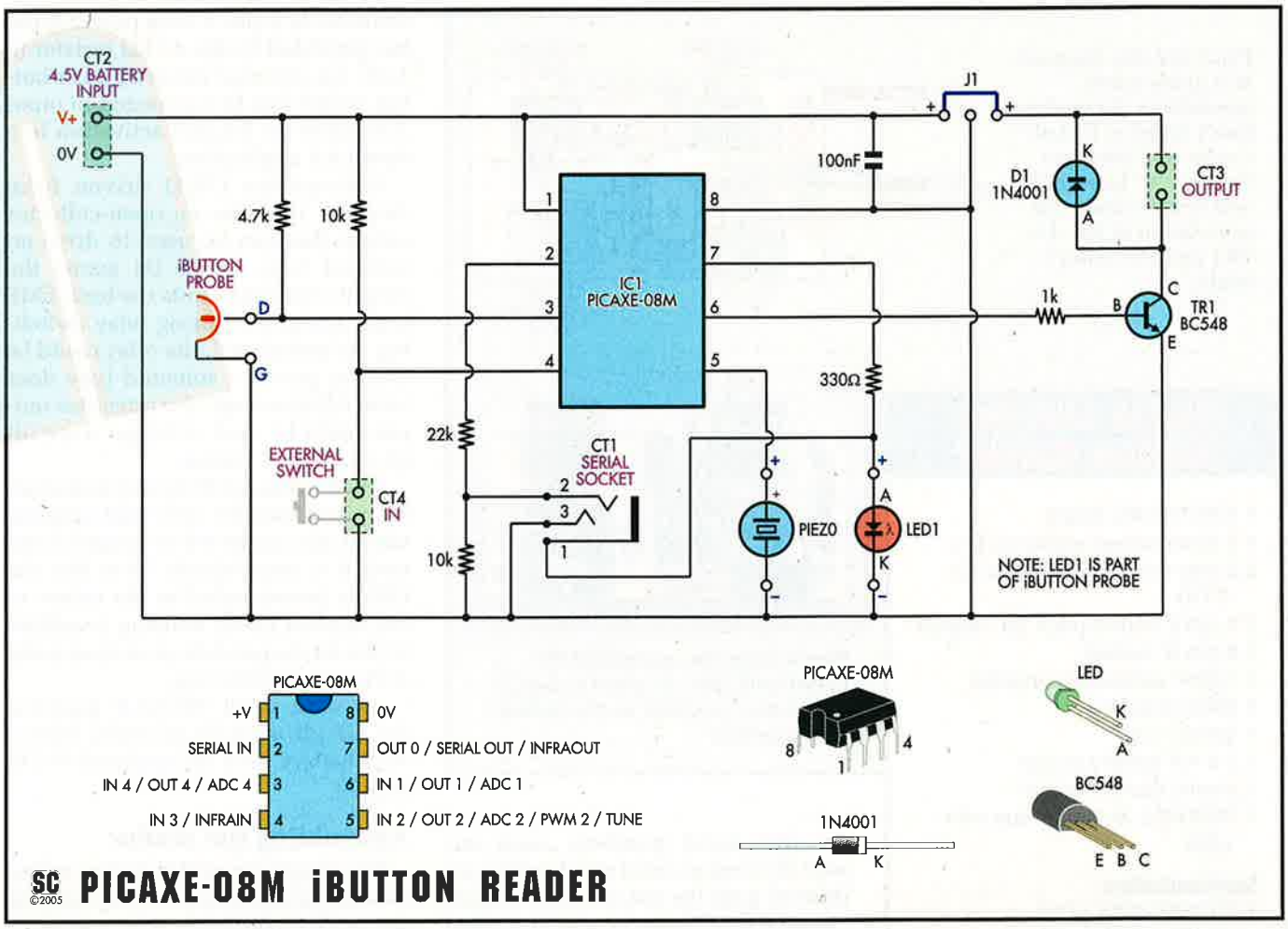


Fig.1: here's the circuit diagram for the reader. The data line from the iButton probe is connected to input 4 of the PICAXE microcontroller (IC1), with power to the probe provided by a 4.7kΩ pull-up resistor. The transistor (TR1) can be used to drive an external relay when a valid iButton serial number is detected.

same connection, providing its serial number and more, depending on the type of device.

For obvious reasons, Dallas refers to this ultra-simple power and data connection method as a "1-Wire" interface. The relatively complex communications protocol used over the interface is known as the 1-Wire protocol. Communications speed is 16kbps in "standard" mode and 142kbps in "overdrive mode".

The iButton can transmit a surprisingly amount of information in a relatively short time. In fact, it is almost impossible to tap an iButton against a probe quicker than the time required by the iButton to transmit its serial number. This makes the iButton an ideal device for applications such as locks where operation must appear to be virtually instantaneous.

As the 1-Wire interface provides power to the iButton, most devices do not require an internal battery. Together with their robust steel casing, this makes for a product with a very long life span.

PICAXE iButton reader

Due to the complexity of the 1-Wire protocol, iButton readers are typically microcontroller based and this is where our PICAXE project for this month comes in. Using the PICAXE BASIC command **readowsn** (for **read**

The kit includes one DS1990A iButton and a plastic fob which are easily snapped together.

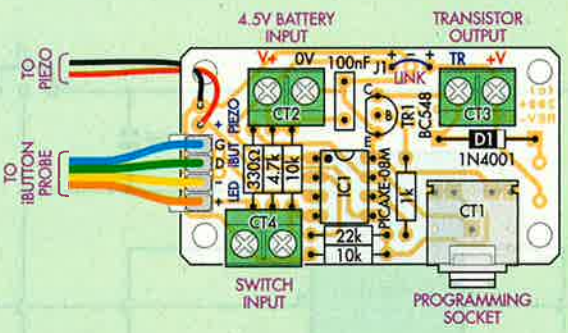
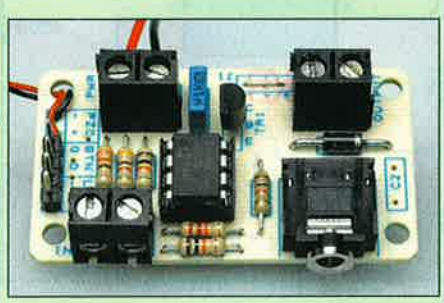


Fig.2: use this diagram as a guide when assembling the reader. Don't forget to install a wire link between the two "+" holes at J1 and double-check the orientation of IC1, D1, TR1 and the battery leads.



Here's what the assembled PC board look like. As shown, the C2 component position on the board is left vacant.

Parts List For iButton Reader

1 AXE109 PC board
1 3.5mm stereo socket (CT1)
3 2-way terminal blocks (CT2-CT4)
1 4-pin 2.54mm-pitch SIL header
1 8-pin IC socket
1 100nF polyester capacitor
1 piezo sounder
1 battery clip
1 3 x AA battery holder
1 plastic iButton holder
1 DS9092L iButton probe with LED

Semiconductors
1 PICAXE-08M (IC1)
1 1N4001 diode (D1)
1 BC548 transistor (Q1)
1 DS1990A Serial Number iButton

Resistors (0.25W 5%)
2 10kΩ
1 4.7kΩ
1 330Ω
1 1kΩ
1 22kΩ

Also required (not in kit)
PICAXE Programming Editor software (v4.1.0 or later)
PICAXE download cable (part no. AXE026)
3 x AA alkaline cells

Obtaining Kits & Software

The design copyright for this project is owned by Revolution Education Ltd. Complete kits (part no. AXE109) for this project are available from authorised PICAXE distributors – see **www.picaxe.com.au** or phone Microzed on (02) 4351 0886. The PICAXE Programming Editor software can be downloaded free of charge from **www.picaxe.co.uk** or ordered on CD (part no. BAS805).

one-wire serial number), users can read the unique serial number from an iButton with the aid of a very simple circuit and without detailed technical knowledge of the protocol.

The circuit for the PICAXE-08M iButton reader appears in Fig.1. As shown, the circuit could be used to drive a solenoid type lock (via a relay) but is probably more suitable for use as a building block within more complex circuits.

PICAXE enthusiasts will find the circuit quite straightforward. The 1-Wire bus from the iButton probe connects to *input 4*, with power to the bus provided by the 4.7kΩ resistor to 4.5V. An optional external push-button switch can be connected to *input 3* to allow for manual activation in a door lock application.

A transistor (TR1) driven from *output 1* provides an open-collector output that can be used to drive an external relay. Diode D1 across the output terminals limits the back-EMF spike generated during relay switching. As mentioned, the relay could be used to power a solenoid type door lock. Alternatively, the transistor output could be used to trigger a circuit of your own creation.

All that remains to be mentioned are the piezo sounder and LED outputs, which are connected to *output 2* and *output 0*, respectively. Note that the LED is incorporated in the centre of the iButton probe housing (supplied in the kit) to provide an aiming point during night-time use.

As with most PICAXE projects, the circuit must be powered from a 4.5V battery pack or regulated 5V DC supply.

Assembling the reader

The simplicity of this design makes for a very simple PC board layout with few parts, so assembly is very straightforward. Using the overlay diagram in Fig.2 as a guide, begin by installing the resistors, diode (D1) and IC socket for the PICAXE-08M (IC1).

Take particular care that the notch in the IC socket matches that shown on the diagram. This will be used as a guide when plugging in the PICAXE chip, which also has a notch on one end. Also note that the cathode (banded) end of the diode (D1) must

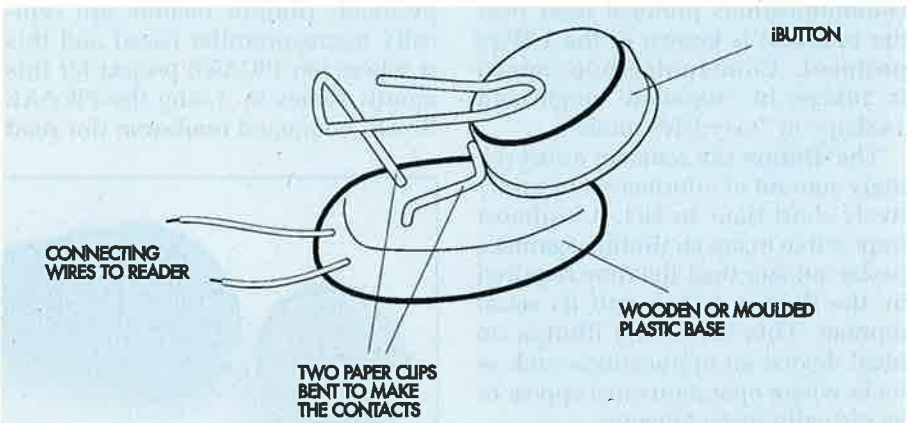


Fig.3: it's easy to make your own probe for experimental purposes using a pair of paper clip "contacts" anchored to a wooden or epoxy resin base.

An iButton can be attached to a plastic card and used for access control instead of magnetic stripe technology.

There's no traditional key slot in this door handle – just a probe to accept an iButton for user identification!

be oriented as shown.

Use one of the resistor lead off-cuts to make a link (J1) between the two pads marked "+". Following that, install the 100nF capacitor and transistor TR1, noting that the flat side of the transistor must face the capacitor.

All of the connectors (CT1-CT4) can go in next. You may find that the kit includes one 2-way and one 4-way screw-terminal block. The 4-way terminal block is easily converted into two 2-way blocks simply by snapping (or sliding) it apart! Push the stereo socket (CT1) down firmly so that it snaps into place before soldering.

The final step is to install a 4-way single-in-line (SIL) header strip for connection to the iButton probe. This is probably supplied in a 10-way strip in the kit but is easily cut down to the correct length with a sharp knife or side cutters.

The battery clip and piezo sounder can now be connected to the board. It is crucial that the battery leads are connected around the right way; otherwise, the PICAXE chip will be destroyed at power up! To reiterate,

iButton At *The Big Idea* Exhibition

Mechanisms exhibit at *The Big Idea* exhibition (photograph © Revolution Education Ltd 2000).

The Big Idea is a permanent £13 million ($A31 million) technology millennium exhibition, located on the site of Alfred Nobel's dynamite factory in Ardeer, Scotland. It is essentially a giant inventors' workshop, with a large number of hands-on exhibits explaining the principle themes of technology and invention to children.

The visitor's iButton tag activates the various exhibits. (photograph © Revolution Education Ltd 2000)

The Big Idea uses a custom iButton tracking system developed by Revolution Education Ltd. On entry to the exhibition, each visitor is given an iButton tag housed in a plastic key fob. At the same time, the visitor's name and postcode is entered into the computer system, along with their unique iButton serial number.

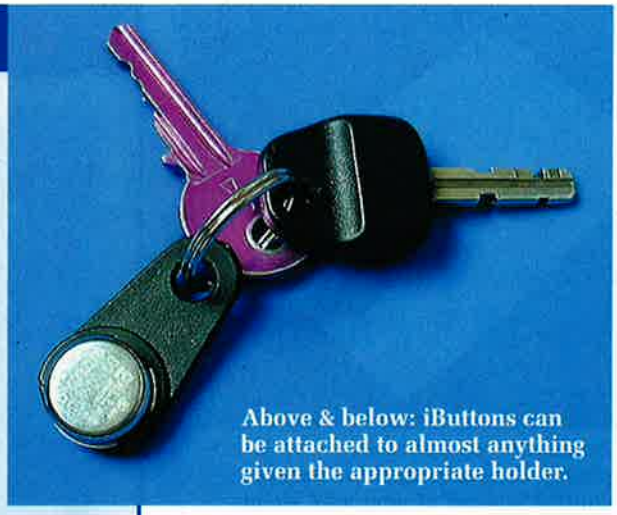
As the visitor moves around the exhibition, the iButton tag is used to activate the various exhibits. At the interactive computer screens, the visitor is welcomed by name when the iButton is touched, whereas at the physical exhibits, the iButton activates the exhibit and sets a timeout period.

One of the many unique features of *The Big Idea* is that each visitor is given an inventor's pack to build and take away. These packs are dispensed by a vending machine, once again triggered with the touch of an iButton.

Each time a visitor's iButton is used, the time and location are logged by a computer system. This is used to create a personal "certificate of achievements", which is available for collection at the end of the day.

Listing 1

```
main:
  let b6 = 0                    'reset family code to 0
  low 0                         'LED off
  low 1                         'output off

loop:
  toggle 0                      'LED on or off
  if pin3 = 0 then open         'switch pushed?
  pause 250                     'wait
  readowsn 4                    'read serial number on input4
  if b6 <> 0 then test          'ibutton detected
  goto loop

' iButton detected so check serial number,
' if wrong number then jump back to start

test:
  sound 2,(50,50)               'beep
  high 0                        'probe LED on
  if b13 <> $FA then main       'modify all of these
  if b12 <> $00 then main       'to match your unique
  if b11 <> $00 then main       'iButton serial number!
  if b10 <> $0B then main
  if b9 <> $23 then main
  if b8 <> $A1 then main
  if b7 <> $00 then main
  if b6 <> $01 then main

' Everything is OK so switch output on for 5 secs

open:
  sound 2,(100,50)              'beep
  high 1                        'LED on
  high 2                        'output on
  pause 5000                    'wait 5 seconds
  goto main
```



Above & below: iButtons can be attached to almost anything given the appropriate holder.

the red wire from the clip goes to 'V+" and the black wire to "0V". As you can see from the diagram and photos, the piezo leads can be threaded through the adjacent corner hole before soldering to provide strain relief.

PICAXE program

The BASIC program in Listing 1 shows how easy it is to read an iButton serial number using the PICAXE-08M. When a valid serial number is returned by the **readowsn** command, it is compared with a predefined 16-digit (8-byte) number.

If the numbers match, the transistor is switched on for five seconds and the piezo generates a two-tone sound. If not, a single tone is generated instead and the program loops back to the start.

Finally, the **toggle** command is used to flash the LED in the centre of the iButton probe, allowing you to find it in the dark of night!

Note that you must alter the serial number values where indicated to match the unique code that is laser engraved in "2-12-2" format on the face of your iButton. For example, the iButton used with the program in Listing 1 would be engraved like this:

FA 01
00000B23A100

Each unique code uses the hexadecimal digits 0-9 and A-F. Do not confuse D with 0 or B with 8!

Making your own probe

As described earlier, the two connections necessary for iButton operation (power/data and ground) are made with a purpose-built probe. Although off-the-shelf probes are readily available, it's a relatively simple matter to make your own for experimental purposes. As shown in Fig.3, a pair of paper clip "contacts" could be anchored to a base such as wood or epoxy, for example.

However, if you have a serious application in mind, you will probably want to purchase the kit for this project as it includes a professional quality probe with an embedded LED (see photo).

Want more information?

The iButton is an interesting low-cost technology that can be incorporated into numerous projects. By modifying the circuit provided, the iButton can become the "key" to many exciting projects!

Detailed information about the iButton range is available from the Dallas Semiconductor/Maxim website at **www.iButton.com** SC

The complete iButton datalogger starter pack includes one DS1921G iButton, a Blue Dot adapter, USB adapter and Windows-based software.

By Clive Seager*

The DS1921 iButton

. . . a temperature datalogger in a 16mm stainless steel can!

One of a range of datalogging iButtons, the DS1921 houses a battery and an embedded computer chip that integrates a temperature sensor, a clock/calendar and memory.

THE MEASUREMENT RANGE for the DS1921 iButton's temperature sensor is -30°C to +85°C in 0.5° increments, while the clock measures seconds to years accurately to +1 minute per month from 0°C to 45°C. Incredibly, the iButton can log data for more than 10 years, or up to 1 million temperature measurements.

As well as the datalogging memory, these devices also incorporate a further 512 bytes of user memory. This space could be used to store a product description, shipping manifest or even a student's name, for example.

All iButtons include a unique 16-digit silicon serial number for identification. As described in our previous iButton article, this serial number can be read out using a simple PICAXE-08M circuit and BASIC program. Unfortunately, PICAXE BASIC does not include any commands that enable us to easily access the DS1921's other resources over the 1-Wire bus.

However, iButton manufacturer Dallas Semiconductor and Revolution Education have produced a general-purpose Windows-based application

A Commercial Application: Making Sure The Fish Stayed Cold

The DS1921 iButton belongs to the Thermochron family of dataloggers, which include devices with high accuracy measurements, larger memories and even humidity measurement capabilities. These devices continue to be applied in a wide range of commercial applications, including food quality control, as highlighted in the following example.

Around the coast of Scotland and Canada, aqua-culture farms rear salmon for sale to restaurants around the world. Many salmon are destined for Japan and therefore must be transported by air, packed in crates of ice.

It is naturally very important that the fish are maintained at the correct temperature during the journey, particularly if they are subjected to delays at the airport terminals. For this reason, it is desirable to constantly monitor the temperature of the fish over the duration of the journey.

The DS1921 iButton temperature datalogger is ideal for this purpose. This small, low-cost iButton is easily clipped onto a piece of plastic and placed beside the fish in each crate. The iButton is programmed to take readings every 30 minutes and its memory is programmed with the shipping details, such as lot number and batch quantity.

As the iButton contains an internal battery, it operates completely autonomously, requiring no external connection to perform its pre-programmed datalogging tasks.

When the crate arrives at its destination in Japan, the merchant can retrieve the iButton, connect it to a laptop or Palm computer and upload the data. The temperature readings can be displayed as a graph and the merchant can check that the salmon have been stored between the correct temperature thresholds for the entire journey. If the temperature limits have been exceeded the fish are rejected and destroyed. This ensures that only

the finest quality fish are sold on to the restaurants.

The iButtons are collected and then mailed back to the salmon farms so that they can be reused. As the iButton has a life span of up to 10 years, it can be reused many times, making it a very cost-effective datalogging device.

that provides full access to the iButton's resources. The software is well suited for use in a classroom or laboratory situation, as it provides all that's necessary to initiate datalogging and retrieve mission results.

To use the software, the iButton's 1-Wire bus must be hooked up to the PC's serial or USB ports. Let's see how it all works.

Configuring the iButton

Before the computer chip in an iButton will begin logging temperature and time information, the user must first set a number of key parameters. These are as follows:

- Set the internal clock to the current date and time.
- Enter mission details (eg, student name and purpose of experiment).
- Set the sample rate (1 minute to 255 minutes).
- Set the upper and lower temperature alarm threshold values.
- Set the mission start delay (time before the mission starts – up to 45 days).

To perform the configuration, the iButton is clipped into a "Blue Dot" adapter, which is in turn connected to a computer via its serial or USB port. The Windows software can then be used to set all of the parameters and initiate the mission.

Once configuration is complete, the iButton is removed from the Blue Dot adapter and placed in the logging position. The iButton's stainless steel case withstands dirt, moisture and rough treatment and its small size means that it can be attached unob-

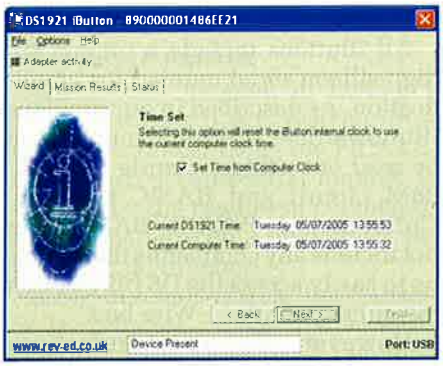

DS1921 iButton - 890000001486EE21
File Options Help
Adapter activity
Wizard | Mission Results | Status
Time Set
Selecting this option will reset the iButton internal clock to use the current computer clock time.
Set Time from Computer Clock
Current DS1921 Time: Tuesday 05/07/2005 13:55:53
Current Computer Time: Tuesday 05/07/2005 13:55:32
< Back
Next >
www.rev-ed.co.uk
Device Present
Port: USB

Fig.1: software supplied with the starter pack makes it very easy to configure the iButton for a mission.

Fig.2: once a mission has been launched, its status can be viewed at any time.

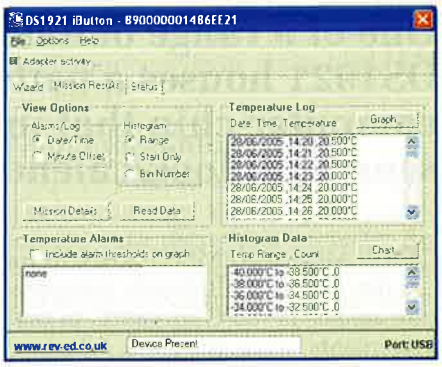


Fig.3: current mission data is automatically downloaded from the iButton when the software is launched.

trusively to most container surfaces or walls.

This could include bottles, boxes, crates, pallets, air cargo containers, refrigerators, semi-trailers, etc.

Retrieving mission data

When the mission is complete, the iButton is retrieved and clipped into the Blue Dot adapter again. The software is then used to extract mission data. Reports and graphs can be generated from the data and it can be exported in CSV format for use in other applications (eg, Excel).

Data storage in detail

The iButton stores data in three different ways that serve different application needs, as follows:

(1). TEMPERATURE LOGGING: the iButton can take 2048 time and date stamped temperature readings at equal intervals, spaced between 1 and 255 minutes. At a 1-minute interval, this equates to about 1.4 days, whereas at a 255-minute interval, this equates to almost a year of continuous operation. The battery lasts for 10 years, so almost a million readings are possible in this time.

To fully utilise the recording mission, the user chooses the time to begin temperature taking, sets a sampling rate, sets high and low alarm thresholds, and determines whether to "roll-over" when 2048 time and temperature readings are completed (or to simply stop logging at that point).

(2). HISTOGRAM BINS: the iButton also simultaneously stores each temperature sample in a histogram. The histogram memory consists of 56 bins in 2° increments; each bin can hold up to 65,500 temperature readings. The histogram method of data storage serves applications that require long-term monitoring or the ability to instantly assess whether a minimum or maximum threshold has been compromised.

For example, when storing blood or other biomedical products, it is critical to know if certain user-defined temperature thresholds have been exceeded. The histogram instantly reveals this information, together with the length of time the thresholds have been exceeded. The histogram keeps recording after the standard log is full.

(3). THRESHOLD ALARMS: both upper and lower threshold alarms can be set. If the iButton temperature exceeds these thresholds at any point an alarm time/date stamp will be recorded. This reveals exactly when, and for how long, an alarm threshold was exceeded.

The "Blue Dot" adapter provides a connection point for one or two iButtons during configuration and data retrieval. Hook-up to the PC is made via an RS232 serial or USB adapter.

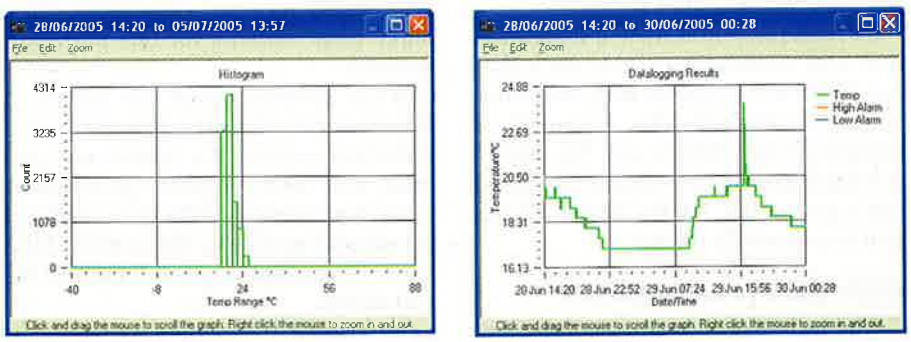


Fig.4: graphs and charts of the results can be instantly displayed and printed. They can also be exported in CSV format from the main toolbar.

Summary

Dallas Semiconductors' iButtons open up a completely new world of datalogging possibilities. Check out their website at **www.iButton.com** for all the details.

As well as their many commercial applications (see panel), Revolution Education believe that the low-cost DS1921 temperature dataloggers will find use in the lab and classroom. To this end, they are making a complete "starter pack" available.

The iButton datalogger starter pack (Part No. LOG001) contains a DS1921 iButton, Blue Dot adapter, USB adapter and PC software on CD and is available from **www.microzed.com.au** or phone MicroZed on (02) 4351 0886. Individual iButtons are also available from MicroZed. **SC**

*** About the author: Clive Seager is the Technical Director of Revolution Education Ltd, the developers of the PICAXE system.**

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Salvage It!

BY JULIAN EDGAR

A $5 2-channel vibration sensor

Want to make a vibration sensor for just a few dollars? All you need is an old cassette deck and a couple of loudspeakers!

THIS 2-CHANNEL vibration sensor costs almost nothing to make but is sensitive enough to detect a cat walking past on a wooden floor!

To make it, you'll need a discarded (but still working) cassette deck that has VU meters (these can be either analog or digital) plus a couple of loudspeakers, which can be easily salvaged from an old stereo TV. If you can't score that lot for under $5.00, you're not really trying.

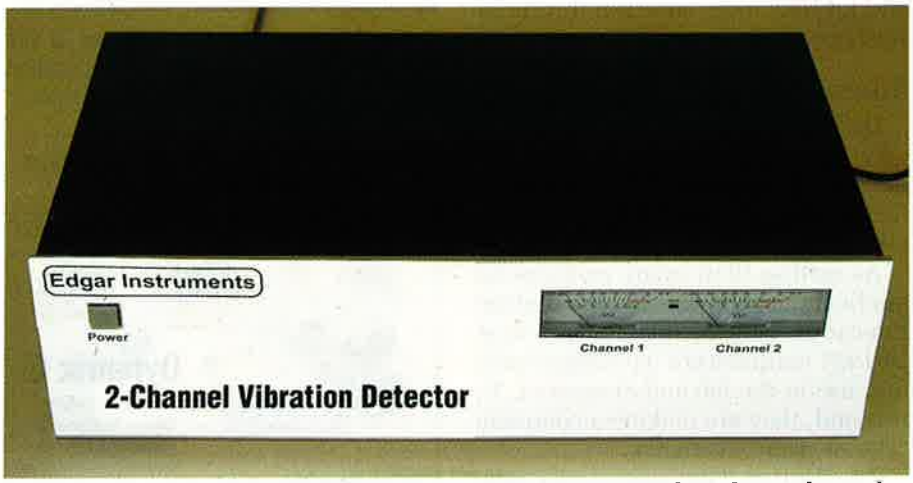
High-gain preamplifiers

The unit takes advantage of the fact that a cassette deck uses two high-gain preamplifier stages that work with very small signals. Normally, these signals are read off the tape by the heads but what we do here is feed in new signals which are derived from coils of wire moving in a magnetic field. And since loudspeakers have very strong magnets, coils with lots of windings and very small internal clearances, they make ideal sensors for our vibration detector.

If the speaker basket (or frame) is firmly attached to the ground and a vibration occurs, the basket and the cone will tend to move at different rates. For example, if there is a sudden movement upwards, the inertia of the cone means that it gets left behind for a moment.

As a result, the magnet will move in relation to the coil (which is attached to the cone) and a small voltage will be generated.

This voltage is amplified and displayed on the cassette deck's VU meters. The greater the needle deflection, the greater the amount of vertical vibration that has occurred.



It looks like a $1000 instrument but costs less than $5 to make. This 2-channel vibration detector is actually based on a slightly modified cassette deck and uses conventional loudspeakers as vibration sensors. It's sensitive enough to detect a cat walking past on a wooden floor.

Building it

At its simplest, the vibration detector will take only a few minutes to make. First, make sure that the power cord is disconnected from the mains supply and then take the cover off the cassette deck. Now trace the leads (they'll be shielded) that connect the PC board to the heads. There will be six conductors in all – a common, play and record signal feed for each head.

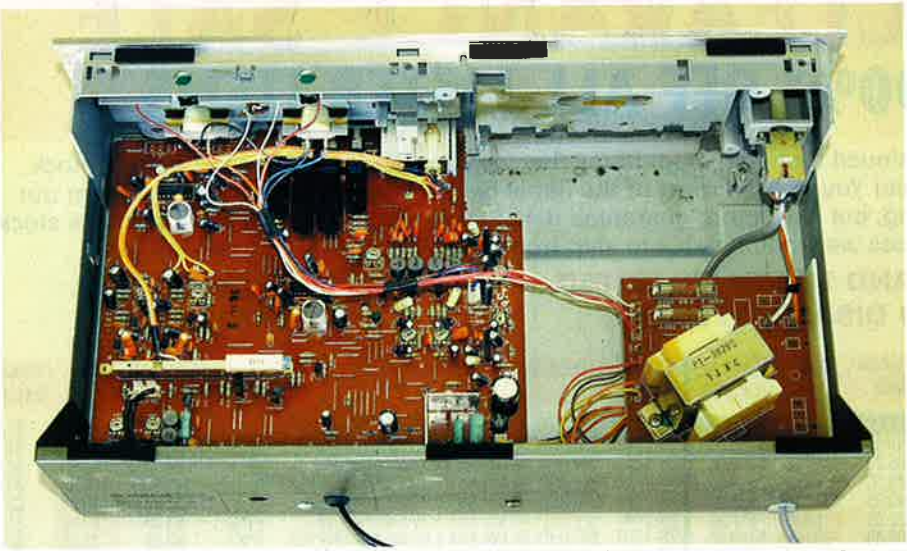
Cut these wires and feed them out of the case. That done, replace the lid, power-up the deck, press the "Play" button and then connect a speaker across the wires for one channel, trying various combinations until you find a pair which causes a VU meter to strongly react to any speaker movement.

Now do the same for the other channel. You may need to extend these leads and in our case, we used the RCA cables that came with the deck.

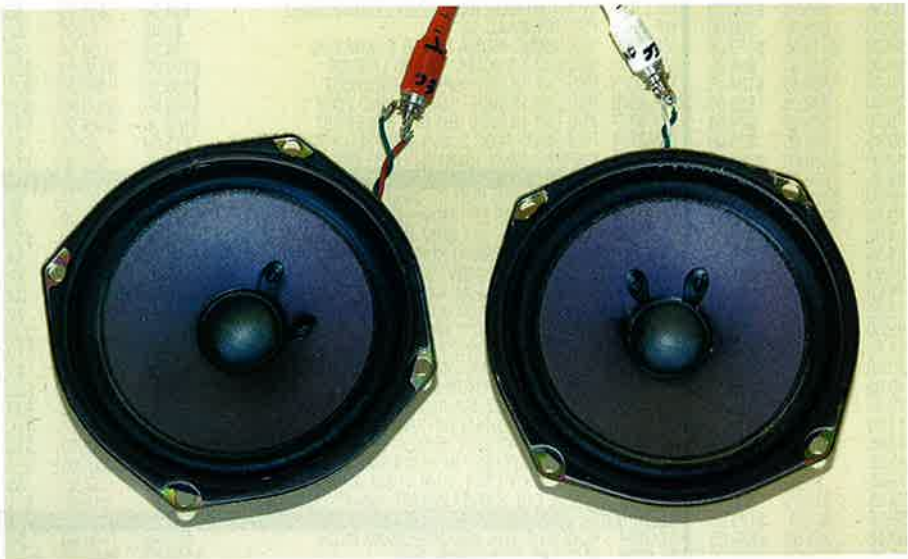
While we were at it, we also stripped the cassette deck of the surplus parts. For example, the complete tape mechanism was removed. Why? Well, the DC motor, drive belts and springs can find a use in another project, as can the tape counter. There's no need to leave them inside the "unit".

Of course, if you take this approach, you'll need to activate the same switches that pressing the "Play" button normally does. For example, if a single switch is closed when "Play" is pressed, the wires leading to that switch will need to be connected together. On the other hand, you may find that when the cassette mechanism is removed, the unit is effectively always in "Play" mode.

Note too that different speakers will give different sensitivities. We tried a



We chose to remove the internal bits and pieces that were no longer needed – the cassette mechanism, tape transport buttons, access door and so on. This allows these parts to be used in other projects and gives a much lighter unit.



The loudspeakers detect vibration and generate a small voltage as the magnet moves past the voice-coil in each unit. The larger the speakers, the more sensitive the instrument.

variety and found that the larger the speaker, the more sensitive the unit became.

The speakers shown here (100mm units salvaged from a stereo TV) were used in the author's unit and give a noticeable reading when anyone walks anywhere in the house (a two-storeys-on-stilts Queenslander). And that even includes walking on the concrete pad under the house!

As I type this, the unit is on my desk; with each normal force keystroke, the display meters are reading just under full-scale!

New faceplate

To make the unit look less like a cassette deck and more like a vibration detector, you can make a new faceplate. If the original faceplate is removable (most are), take it off and scan it into your PC. You can then use image manipulation software to construct the new visuals, putting on whatever labels you want.

That done, print it out at full-size on heavy stock, gloss paper and affix it to the original faceplate. The label can then be protected using clear contact adhesive film or a couple of strips of broad adhesive tape.

Another option is to replace the scale behind the VU meters. You can make the scale read anything you like but in the case of the unit shown here, we elected to keep the original scales.

Changing the sensitivity

If the sensitivity of the unit is too great, simply reduce the size of the speaker. Adding weights to the cone also alters the response.

When exploring the use of different speakers, be aware that a typical house is full of background vibrations. The compressor in the fridge can cause sufficient vibration to swamp other signals, while a PC cooling fan can also cause clearly visible room vibration. So to be able to watch earth vibrations caused by (say) visitors walking up to your front door, you'll need to remotely mount the speaker sensor away from this house-borne noise – but note that the sensitivity will be reduced if the cable is too long.

Logging the output

Finally, if you want to feed the output signal into a logging system or drive an external display, line-level output voltages will be available on the normal RCA outputs of the deck. SC

Rat It Before You Chuck It!

Whenever you throw away an old TV (or VCR or washing machine or dishwasher or printer) do you always think that surely there must be some good salvageable components inside? Well, this column is for you! (And it's also for people without a lot of dough.) Each month we'll use bits and pieces sourced from discards, sometimes in mini-projects and other times as an ideas smorgasbord.

And you can contribute as well. If you have a use for specific parts which can easily be salvaged from goods commonly being thrown away, we'd love to hear from you. Perhaps you use the pressure switch from a washing machine to control a pump. Or maybe you salvage the high-quality bearings from VCR heads. Or perhaps you've found how the guts of a cassette player can be easily turned into a metal detector. (Well, we made the last one up but you get the idea . . .)

If you have some practical ideas, write in and tell us!

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QC-3716	CAMERA CCD B&W DOME DIN	$79.95	$34.95	$45.00
QC-3455	CAMERA CCD B&W IR W/LEAD&PSU	$119.95	$69.95	$50.00
QC-3714	CAMERA CCD B&W MTL - DIN IR	$109.95	$69.95	$40.00
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QC-3444	CAMERA CCD COL DOME 1/3IN SONY W/IR	$369.00	$184.00	$185.00
QC-3262	CAMERA CCD COL TX ADDITIONAL SUITS QC-3260	$179.00	$69.95	$109.05
QC-3704	CAMERA CCD MTL PIR - DIN IR	$169.95	$69.95	$100.00
QC-3702	CAMERA CCD PLAST PIR - DIN IR	$149.95	$59.95	$90.00
QC-3216	CAMERA CCD ROTATING B&W W/CTRLR	$299.00	$119.95	$179.05
QC-3257	CAMERA CMOS B&W TX ADDITIONAL SUITS QC-3255	$159.00	$69.95	$89.05
QC-3255	CAMERA CMOS B&W TX W/LESS & RECEIVER	$269.00	$84.95	$184.05
QC-3271	CAMERA CMOS COL 2.4GHZ CH1 PSU SUIT QC-3270	$129.00	$69.95	$59.05
QC-3275	CAMERA CMOS COL IR 2.4GHZ CH4 SUITS QC-3274	$179.00	$99.95	$79.05
QC-3454	CAMERA CMOS COL PINHOLE W/AUD&PSU	$89.95	$69.95	$20.00
QC-3390	CAMERA COL IP/NETWORK 640X480 PIXEL	$349.00	$189.00	$160.00
QC-3380	CAMERA DIG PEN CMOS RS232 W/LEAD SKT D9	$99.95	$49.95	$50.00
QC-3295	CAMERA DOME V/FOCAL F4.0-F9.0MM 380TVL	$249.00	$189.95	$59.05
QC-3320	CAMERA LENS AUTOIRIS STD C/CS F1.8 4MM	$279.00	$219.95	$59.05
QC-3340	CAMERA LENS CS MOUNT 4MM ECON	$24.95	$5.50	$19.45
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QC-3324	CAMERA LENS W/AUTO IR STD C/CS F80	$119.00	$59.95	$59.05
QC-3395	CAMERA USB PAN/TILT W/REMOTE SLV	$299.00	$229.00	$70.00
QC-3384	CAMERA WRIST WATCH PDA W/GAMES	$89.95	$59.95	$30.00
QC-3254	CAMERA/MONITOR CMOS B&W W/LESS 2.4GHZ	$279.00	$149.50	$129.50
LA-8907	DETECTOR U/SONIC TX/RX/CASE (CAR ALARM)	$49.95	$19.95	$30.00
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QV-3056	INTERFACE CARD PCI VIDEO CAPT 4CH 5F/SEC	$349.95	$229.95	$120.00
LA-5474	KEYPAD ALARM & CTRLR FOR HOMENET SYSTEM	$59.95	$19.95	$40.00
QC-3457	LEAD CCD CAM EXT MINIDIN/6P 20M	$19.95	$9.95	$10.00
LA-5162	LIGHT NIGHT W/PIR & LIGHT SENSOR 6LED	$24.95	$14.95	$10.00
QM-3402	MONITOR 10IN B&W	$199.50	$69.95	$129.55
QM-3403	MONITOR 10IN B&W 4CH	$259.50	$89.50	$170.00
QM-3407	MONITOR 12IN B&W QUAD W/QUAD RCA OUT	$599.50	$299.50	$300.00
QM-3751	MONITOR LCD TFT 7IN ROOFMOUNT 12V IR	$329.00	$269.00	$60.00
QC-3730	MONITOR QUAD B&W W/4 CAMERA MTL CMOS	$899.00	$399.00	$500.00
LA-5025	PIR DETECTOR QUAD SENSOR PROTON	$39.95	$24.95	$15.00
LA-5040	PIR PULSE MICROWAVE SENSOR PROTON	$79.95	$59.95	$20.00
LA-5030	PIR PULSE W/BRKT 12V MICRON N/C	$29.95	$14.95	$15.00
LA-5035	PIR PULSE W/BRKT 12V MICRON N/O	$39.95	$19.95	$20.00
QC-3372	QUAD PROCESSOR B&W W/AUDIO DOMESTIC	$119.00	$89.00	$30.00
QV-3066	RECORDER VIDEO DVR 1CH W/AUDIO&120GB HDD	$799.00	$595.00	$204.00
LR-8864	SENSOR PARKING W/BEEPER&2SENSORS	$89.95	$44.95	$45.00
QC-3392	VIDEO CAPTURE IP/NETWORK 4INPUT	$349.00	$189.00	$160.00
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QC-3394	VIDEO WEB SERVER (IP/NETWORK) 2CH W/PSU	$399.00	$289.00	$110.00
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MP-3070	BATTERY BANK NI-MH FOR DIG CAMERAS	$99.95	$39.95	$60.00
MB-3520	BATTERY CHGR CAR 12V@4A AUTO W/CLIPS	$39.95	$14.95	$25.00
MB-3535	BATTERY CHGR NI-CD/NI-MH FAST 4AA/AAA 12V	$34.95	$15.95	$19.00
MB-3566	CHGR ADPT SUITS MB-3550 -JVC;CANON;PANASONIC	$12.50	$4.95	$7.55
MB-3565	CHGR ADPT SUITS MB-3550 -SHARP;HITACHI;SONY	$12.50	$4.95	$7.55
MB-3582	BATTERY CHGR W/CR123A/CIG PLG & ADPT	$44.95	$19.95	$25.00
MB-3584	BATTERY CHGR W/CRV3/CIG PLG & ADPT	$59.95	$24.95	$35.00
SB-1621	BATTERY LITHIUM BACKUP CR2430RH 3V 285MAH	$4.95	$2.50	$2.45
SB-1740	BATTERY LITHIUM CR123A 3.6V 600MAH RECHARGE	$19.95	$7.50	$12.45
SB-1742	BATTERY LITHIUM CRV3 3.6V 1500MAH RECHARGE	$29.95	$14.95	$15.00
SB-2463	BATTERY NI-CD 1/2SUB C 1.2V 600MAH SANYO	$8.95	$4.95	$4.00
SB-1630	BATTERY NI-CD AA 1.2V 600MAH SANYO NIPPLE	$4.25	$2.50	$1.75
SB-1632	BATTERY NI-CD AA 1.2V 600MAH SANYO TAG	$4.50	$2.95	$1.55
SB-2470	BATTERY NI-CD BUTTON 1.2V 280MAH	$3.15	$0.85	$2.30
SB-1710	BATTERY NI-MH 4/3A 1.2V 3000MAH TAG	$12.95	$4.95	$8.00
SB-2450	BATTERY NI-MH 4/3A 1.2V 4000MAH TAG VARTA	$19.50	$9.95	$9.55
SB-1718	BATTERY NI-MH 4/5A 1.2V 1800MAH TAG	$8.95	$1.74	$7.21
SB-1732	BATTERY NI-MH AA 1.2V 1200MAH TAG	$3.25	$1.35	$1.90
SB-1702	BATTERY NI-MH AA 1.2V 1650MAH TAG	$4.75	$1.95	$2.80
SB-1712	BATTERY NI-MH AA 1.2V 1800MAH NIPPLE PK4	$15.95	$6.95	$9.00
SB-1726	BATTERY NI-MH AA 1.2V 2300MAH TAG	$6.25	$2.95	$3.30
SB-2446	BATTERY NI-MH AAA 1.2V 650MAH TAG	$3.25	$1.45	$1.80
SB-1720	BATTERY NI-MH AAA 1.2V 800MAH NIPPLE	$3.59	$1.25	$2.34
SB-1722	BATTERY NI-MH AAA 1.2V 800MAH TAG	$3.78	$1.65	$2.13
SB-2473	BATTERY TEL NI-CD 3.6V 280MAH PACK TRI	$14.50	$10.95	$3.55
SB-2472	BATTERY TEL NI-CD 4.8V 250MAH PACK	$14.50	$10.95	$3.55
SB-2478	BATTERY TEL PANASONIC FLIP BLK	$24.25	$6.95	$17.30
MS-4016	FLTR MAINS INLINE CLOVERLEAF SURGE/IND	$6.45	$3.50	$2.95
MS-4014	FLTR MAINS INLINE FIG8 SURGE/INDICATOR	$6.45	$3.50	$2.95
MI-5100	INVERTER ISOL 100W 12VDC/230VAC 50HZ	$44.95	$39.95	$5.00
MP-3039	PSU 12V/8V AC 1A	$9.95	$7.95	$2.00
MP-2900	PSU 12VDC 450MA UNREG 2.5MM PLG	$8.95	$4.95	$4.00
MP-3095	PSU LAB 1.5-30VDC 1A REG LASCAR	$199.00	$139.95	$59.05
MP-3073	PSU LAB 13.8VDC 5A REG BIND POST	$109.50	$85.95	$23.55
MP-3076	PSU LAB 13.8VDC 10A REG BIND POST	$169.50	$129.95	$39.55
MP-3077	PSU LAB 13.8VDC 15A REG BIND POST	$189.50	$149.95	$39.55
MP-3234	PSU SMPS 7VDC 2-1A 1.3MM PLG KODAK	$15.00	$9.95	$5.05
MS-4031	PWRBRD 6WAY 1SWITCH FLTR LONG WHT	$23.95	$12.95	$11.00
LIGHTING				
SL-2959	CLAMP BLKTO SUIT SL-2960 PINSPOTS	$8.95	$2.95	$6.00
SL-3151	FLUORO TUBE 2FT 240V 20W BLK/LITE	$17.95	$8.95	$9.00
SL-3159	FLUORO TUBE 2FT 240V 40W BLK/LITE	$79.95	$49.95	$30.00
SL-2989	GLOBE 240V 15WTO SUIT SL-2986/87	$6.70	$1.95	$4.75
SL-2761	GLOBE EDISON 240V 75W BLKLIGHT	$9.95	$3.95	$6.00
SL-3209	GLOBE FLANGE HAL 4.8V 500MA	$10.00	$5.95	$4.05
SL-3212	GLOBE TORCH 2.5V 400MA BI-PIN	$1.20	$0.35	$0.85
SL-2979	LIGHT SET - PARTY 3IN1 STROBE/BALL/UV	$59.95	$39.95	$20.00
SL-2967	MINI PAR HAL 12V 20W W/4LENSE/PSU	$29.95	$19.95	$10.00
SL-2960	SPOTLIGHT PAR36 240V 6V/30W NO/GLOBE	$24.95	$15.95	$9.00
ST-3079	TORCH CCFL/XENON/LED	$39.95	$19.95	$20.00
ST-3333	TORCH LED 1W 3AA ALU BLK	$59.95	$29.95	$30.00
ST-3324	TORCH LED W/MAGNIF 2AAA ALU	$29.95	$14.95	$15.00
ST-3058	TORCH LEDX3 WHT HEAD/CLIP	$29.95	$19.95	$10.00
ST-3070	TORCH LEDX3/BI-PIN HEADLAMP ADJ BEAM YEL	$39.95	$29.95	$10.00
SL-3180	TUBE KIT UV COOL 4COLX1.5M W/WIRE&CLIP	$12.95	$7.95	$5.00
SL-2961	WHEEL COL 230MM W/MOT 240VAC (SL2960)	$31.50	$19.95	$11.55
AUDIO/VIDEO				
AX-3654	ACOUSTIC TILE 305X305X32MM ECON	$12.95	$4.95	$8.00
AA-0434	AMP CAR 2X150WRMS RE/S	$289.00	$154.95	$134.05
AA-0438	AMP CAR 4X50WRMS RE/S	$219.00	$134.95	$84.05
LT-3019	BALUN INDOOR 75R/300R RIBBON CABLE OUT	$3.10	$0.75	$2.35
AR-1495	CD DRAWER 60DISC PLAST BLUE & WHITE	$19.95	$11.95	$8.00
AR-1488	CD WALLET 56DISC ZIPPER BLU 290X170X65	$7.95	$5.95	$2.00
AM-4082	MIC MULTIMEDIA W/LEAD PLG 3.5MM SWANNECK	$12.95	$8.95	$4.00
AA-0340	MODULE - 6W MINI MONO	$23.95	$12.95	$11.00
AA-0360	MODULE - SURRND SOUND EXPERIMENTERS	$24.95	$15.95	$9.00
AR-1718	REMOTE CTRL DYNAMO POWERED UNIV 4IN1 SLV	$59.95	$19.95	$40.00
CS-2432	SPEAKER BOX IN/OUTDOOR 4R 25W BLK 3WAY PR	$89.95	$29.95	$60.00
CS-2250	SPEAKER CAR 4IN 20WRMS 2WAY PR	$24.95	$10.95	$14.00
CS-2254	SPEAKER CAR 5IN 25WRMS 2WAY PR	$29.95	$12.95	$17.00
CS-2218	SPEAKER CAR TWEET SUPER DOME 1IN 40W MYLAR	$5.00	$3.15	$1.85
AS-3150	SPEAKER CAR/BOXES 4IN 4R PR	$8.95	$6.95	$2.00
CF-2765	SPEAKER CLIP GRILLE PLAST SHT PK8	$1.50	$0.75	$0.75
AX-3540	SPEAKER CLIP GRILLE SKP KIT	$4.70	$1.95	$2.75
CF-2766	SPEAKER CLIPGRILLE PLAST LNG PK8	$2.50	$0.65	$1.85
CG-2380	SPEAKER PA 12IN 8R 100WRMS CARDBOARD	$99.50	$39.95	$59.55
AM-4054	SPEAKER PA PERSONAL 5W ECON	$49.95	$29.95	$20.00
CX-2695	SPEAKER PORT 110MM ADJUSTABLE	$7.50	$2.95	$4.55
CS-2246	SPEAKER SUB 12IN 4R CARBON RE/S	$159.00	$89.95	$69.05
CS-2240	SPEAKER SUB 6.5IN 4R 80WRMS CARBON RE/S	$55.00	$29.95	$25.05
CS-2228	SPEAKER SUB D/MAG 12IN 4R 150WRMS RE/S	$279.00	$184.95	$94.05
CS-2465	SPEAKER SURRND 3PCE ADD-ON PACKAGE 25W BLK	$99.95	$39.95	$60.00
CT-1924	SPEAKER TWEET PIEZO BULLET 400W KSN1165A	$49.95	$29.95	$20.00
AS-3020	SPEAKER WIDE 2IN/53MM 4R	$3.95	$1.95	$2.00
AC-1690	SWITCH AV 4IN/1OUT W/RF MODULATOR	$99.95	$39.95	$60.00
LT-3280	TV AMP/SPLIT INDOOR F-TYPE W/PSU 30DB+	$129.00	$99.95	$29.05
LT-3286	TV AMP/SPLITTER INDOOR 4WAY 240V GME	$89.50	$69.95	$19.55
LT-3121	TV ANTENNA RABBIT EARS 1004MM EXTENDED	$11.95	$3.95	$8.00
LT-3128	TV ANTENNA TELESC SWIVEL RECT BASE 1030MM	$5.95	$1.25	$4.70

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SPRING CLEARANCE SALE

Cat No	Description	Original RRP	Now	*Save on Orig RRP
COMPONENTS, TEST EQUIPMENT & TOOLS				
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XC-5059	FAN WITH CLEAR LEDS 80MM	$19.95	$11.95	$8.00
XC-5035	FAN 80MM WITH BLUE CCFL & INVERTER	$34.95	$24.95	$10.00
XC-5053	FAN CPU COOLER BALL/B HEATSINK K6/CYRYX	$18.95	$9.95	$9.00
XC-5033	FAN GUARD 80MM PERSPEX WITH TRI-COL LED	$12.95	$8.95	$4.00
XC-5058	FAN TIMER/CTRL 10MIN MAX SUIT 2PC FAN	$39.95	$14.95	$25.00
HH-8518	HEATSINK ALU 10FIN 82X32MM	$2.70	$1.25	$1.45
QP-6012	LASCAR DATALOGGER EL-USB-1	$149.00	$99.00	$50.00
ZD-1739	LED 3MM CLR BI-COL RED/GRN	$0.73	$0.25	$0.48
ZD-0194	LED 5MM CLR WHITE 10000MCD	$3.95	$1.95	$2.00
ZD-2022	LED PINK KIT TOSUIT NOKIA MOBILE PK6	$24.95	$7.95	$17.00
QP-2272	METAL DETECTOR HANDHELD	$69.95	$34.94	$35.01
QM-1665	METER CARBON MONOXIDE LCD, BEEPER & BAG	$229.00	$139.00	$90.00
QP-5035	METER INDASH ANLG 2XVU & 1XVOLT BLUE	$89.95	$39.95	$50.00
QP-5030	METER VOLTAGE PNL ANLG 0-25V BLUE	$19.95	$8.95	$11.00
QP-5032	METER VU ANLG BLUE	$19.95	$8.95	$11.00
YM-2705	MOTOR 3VDC 2250RPM	$2.95	$1.85	$1.10
NS-3032	PEN PCB SILVER CONDUCTIVE 8.59 1/16IN	$33.95	$24.95	$9.00
PP-0636	PLUG LINE SMA MTL GLD RG58U SOLDER	$5.55	$1.95	$3.60
PP-0720	PLUG OBD-II (J1962) W/9PIN	$29.95	$14.95	$15.00
PP-1190	PLUG PCB DIN41612 32WAY ROW A&C	$1.70	$0.50	$1.20
PP-1194	PLUG PCB DIN41612 48WAY ROW A&B&C	$2.20	$0.60	$1.60
PP-1208	PLUG PCB DIN41612 96WAY R/A ROW A&B	$3.10	$1.25	$1.85
PL-0929	SLOT CARD PC 2SKT USB A - 2 SKT MB/5P	$14.50	$6.95	$7.55
PI-6482	SOCKET IC ZIF 24PIN UNIV	$15.95	$5.95	$10.00
PI-6626	SOCKET PLCC SMD 52PIN	$2.65	$1.25	$1.40
QP-2262	TESTER AUTOMOTIVE ALTERNATOR & BATT	$13.50	$6.95	$6.55
QP-2275	TESTER DETECTOR MTL & VOLTAGE	$19.95	$9.95	$10.00
TH-1875	COAX TOOL- CUTTER/STRIPPER/CRIMP DIY	$19.95	$9.95	$10.00
TH-1882	CUTTERS JAYTECH BUDGET	$9.50	$6.50	$3.00
ST-3114	LASER LEVEL DOT/BAR BEAM 7IN W/TRIPOD	$29.95	$19.95	$10.00
TH-2324	PLIERS SLIPJOINT 12IN S/S M/GRADE	$29.95	$11.95	$18.00
TD-2140	RATCHET BOX-END FLEXIBLE 10X11MM	$36.95	$19.95	$17.00
TD-2142	RATCHET BOX-END FLEXIBLE 12X13MM	$39.95	$24.95	$15.00
TD-2054	SCREWDRIVER 7IN1 W/TORCH LIGHT	$24.95	$14.95	$10.00
TS-1352	TIP (WELLER) 1.6MM FLAT PTA6 315DEGC	$14.95	$9.95	$5.00
TS-1362	TIP (WELLER) 1.6MM FLAT PTA7 370DEGC	$14.95	$9.95	$5.00
TS-1365	TIP (WELLER) 1.6MM FLAT PTA8 430DEGC	$14.95	$9.95	$5.00
TS-1401	TIP 0.8MM TO SUIT TS-1400 SOLDERING IRON	$13.95	$3.95	$10.00
TS-1403	TIP 3.2MM TO SUIT TS-1400 SOLDERING IRON	$13.95	$3.95	$10.00
TS-1692	TIP CATALYST TO SUIT TS-1685/90 S/IRON	$13.25	$5.95	$7.30
TS-1411	TIP CONICAL TO SUIT TS-1415 S/IRON	$4.95	$1.45	$3.50
TH-1866	TIP TO SUIT TH-1865 SOLDER SUCKER	$7.05	$1.45	$5.60
TH-1819	TOOL EXTRACTOR V-SHAPE IC 8-28PIN	$2.50	$1.75	$0.75
TH-2314	WRENCH ADJ 10IN S/S M/GRADE	$22.95	$9.95	$13.00
TH-2316	WRENCH ADJ 12IN S/S M/GRADE	$29.95	$11.95	$18.00
COMPUTER ACCESSORIES				
XC-4630	ADAPTOR PC DRIVE BAY 5.25IN-3.5IN	$8.95	$4.95	$4.00
XC-5101	CARD READER GSM SUPER RS232/D9 W/CD	$29.95	$14.95	$15.00
XC-4812	CARD READER USB	$69.00	$34.95	$34.05
HB-6367	CASE LAPTOP ALUMINIUM MEDIUM	$69.95	$44.95	$25.00
HB-6369	CASE LAPTOP ALUMINIUM SMALL	$59.95	$39.95	$20.00
XC-4726	CDR 700MB/80MIN SLV 100PCE	$29.95	$23.95	$6.00
XC-4705	CDR AUDIO DATA 80MIN W/JEWEL CASE	$1.00	$0.75	$0.25
XC-4831	CONVERTER PC USB-IR	$69.95	$44.95	$25.00
XC-5140	SIM CARD SWITCHER COVER FOR NOKIA 3310	$14.95	$5.95	$9.00
XC-4742	DISK 3.5IN IMB 5COL PK25	$13.95	$8.95	$5.00
XC-4648	FILTER MONITOR 19-21IN GLASS BARGAIN	$39.95	$19.95	$20.00
XC-4768	FLASH DISK USB 64MB W/CARD READER USB 2	$64.95	$34.95	$30.00
XC-4632	HARDWARE KIT SUIT PC W/BRKT&FEET	$6.70	$3.95	$2.75
XC-4815	HUB USB 4PORT MINI UNPWRED	$29.95	$12.95	$17.00
XC-5135	KEYBOARD/MOUSE W/LESS PS/2 SLV&BLK	$69.95	$49.95	$20.00
XC-4857	MEDIA PLAYER - REMOTE/PSU/USB/RCA	$149.00	$79.95	$69.05
XC-4700	MINIDISC 74MIN R/W PK5	$16.95	$9.95	$7.00
XC-4842	NOTEBOOK PC LOCK USB W/LESS TX/RX BLK	$69.95	$29.95	$40.00
XC-4880	RADIO X-TREME USB W/IR REMOTE CTRL	$79.95	$49.95	$30.00
XC-5085	RS232 BREAK OUT BOX W/LED/SWITCH/JUMPER	$39.95	$24.95	$15.00
YS-2832	SHREDDER CD MANUAL BLK 215X105X100MM	$39.95	$19.95	$20.00
YS-2830	SHREDDER CD/DVD/DISK/PAPER 240VAC	$99.95	$74.95	$25.00
CABLE & LEADS				
WB-2026	CABLE CAT5E BLUE SOLID - PER METRE	$1.15	$0.99	$0.16
WB-2028	CABLE CAT6 GREY SOLID - PER METRE	$1.95	$0.95	$1.00
WQ-7470	LEAD A/V 2RCA-2RCA 1.5MM RE/S	$69.95	$55.95	$14.00
WQ-7475	LEAD A/V RCA 3PLG - 3PLG RGB 1.8M RE/S	$69.95	$55.95	$14.00
WQ-7480	LEAD A/V SVIDEO PLG - PLG H/Q 1.5M RE/S	$39.95	$31.95	$8.00
WA-1055	LEAD AUDIO RCA 2PLG - 2PLG ECON 1.5M	$7.85	$6.25	$1.60
WA-1056	LEAD AUDIO RCA 2PLG - 2PLG ECON 2.5M	$9.75	$7.75	$2.00
WA-1059	LEAD AUDIO RCA 2PLG - 2PLG ECON 50CM	$6.75	$5.25	$1.50
WA-1058	LEAD AUDIO RCA 2PLG - 2PLG ECON 5M	$13.65	$10.70	$2.95
WQ-7485	LEAD AUDIO SPK BANANA PLG 2.5M H/Q RE/S	$89.95	$71.95	$18.00
WA-1092	LEAD CAR RCA 2PLG - 2PLG T/PR GLD 1.5M	$9.95	$7.75	$2.20
WA-1094	LEAD CAR RCA 2PLG - 2PLG T/PR GLD 3M	$12.95	$10.35	$2.60
WA-1096	LEAD CAR RCA 2PLG - 2PLG T/PR GLD 5M	$17.95	$14.35	$3.60
YN-8183	LEAD CAT5 PATCH 2M BLU PK2	$7.50	$0.75	$6.75
WC-7550	LEAD COMPUTER D25 - MINIDIN/8P MAC MODEM 2M	$7.80	$4.95	$2.85
PL-0950	LEAD COMPUTER FDD 3.5IN 2SKT RND 450MM GRN	$16.95	$12.95	$4.00
PL-0948	LEAD COMPUTER IDE ATA100 3SKT RND 480MM BLK	$24.95	$9.95	$15.00
PL-0972	LEAD COMPUTER IDE ATA133 3SKT RND 600MM BLU	$24.95	$9.95	$15.00
WC-7620	LEAD COMPUTER IEEE1284 D25 - CENT 2M	$22.50	$9.95	$12.55
WC-7628	LEAD COMPUTER IEEE1284 D25 - CENT HPCN36 2M	$22.50	$6.95	$15.55
WC-7530	LEAD COMPUTER KEYBRD DIN/5P PLG - SKT 1.8M	$7.30	$4.95	$2.35
WC-7512	LEAD COMPUTER LAPLINK PAR PLG/PLG D25 1.8M	$9.20	$5.95	$3.25
WC-7548	LEAD COMPUTER MINIDIN/8 PLG-PLG MAC PTR 1.8M	$10.00	$6.95	$3.05
PL-0937	LEAD ETHERNET BNC 10M	$16.95	$9.95	$7.00
PL-0939	LEAD ETHERNET BNC 2M	$6.95	$4.95	$2.00
PL-0938	LEAD ETHERNET BNC 5M	$10.49	$6.95	$3.54
WV-7424	LEAD GAME N64 EXT R2C 1.8M	$6.75	$4.75	$2.00
WV-7420	LEAD GAME PLAYSTATION CTRLR EXT 1.8M	$16.75	$6.75	$10.00
WV-7428	LEAD GAME PLAYSTATION PLG-3PLG RCA 1.8M	$16.75	$6.75	$10.00
GIFTS & GADGETS				
YS-2810	AIR-CON & HUMIDIFIER PERSONAL	$29.95	$19.95	$10.00
ST-3029	BABY COT LIGHT -SOUND ACTIVATED WHITE	$19.95	$6.95	$13.00
GT-3008	BOARD GAME SHOT GLASS SNAKES & LADDERS	$19.95	$9.95	$10.00
QM-7252	BODY FAT ANALYZER W/CLOCK H/HELD BLU	$29.95	$8.95	$21.00
QC-3224	CAMERA 5IN1 DIG CAM/VID/VOICE/WEB/USB	$299.00	$189.95	$109.05
QC-3198	CAMERA DIG 300K PIXEL W/BINOCULARS & BAG	$74.95	$54.95	$20.00
QC-3242	CAMERA W/ADPT MICROSCOPE BLK W/9VDC PSU	$199.00	$119.95	$79.05
QC-3240	CAMERA W/ADPT TELESCOPE SLV W/9VDC PSU	$189.00	$109.95	$79.05
ST-3923	CANDLE HOLDER SUITS ST3920	$5.50	$3.25	$2.25
ST-3926	CANDLE HOLDER SUITS ST-3920 W/ BASE	$5.95	$2.45	$3.50
ST-3920	CANDLE LED TEA LIGHT RECHRG W/LEAD	$14.95	$8.95	$6.00
ST-3922	CANDLE LED TEA LIGHT RECHRG W/PSU&GLASS HOLD	$29.95	$15.95	$14.00
GH-1100	CAR BOOT EXTENDER W/LIGHT & CUTTER	$24.95	$6.95	$18.00
GT-3037	CAR MINI RECHRG W/RC SOUND 27MHZ EVO-7	$29.95	$9.95	$20.00
GT-3039	CAR MINI RECHRG W/RC SOUND 40MHZ ECLIPSE	$29.95	$9.95	$20.00
GT-3038	CAR MINI RECHRG W/RC SOUND 40MHZ RX-7	$29.95	$9.95	$20.00
GT-3032	CAR MINI RECHRG W/RC TURBO 27MHZ EVO-7	$29.95	$9.95	$20.00
GT-3031	CAR MINI RECHRG W/RC TURBO 27MHZ SUPRA	$29.95	$9.95	$20.00
GT-3034	CAR MINI RECHRG W/RC TURBO 40MHZ ECLIPSE	$29.95	$9.95	$20.00
GT-3033	CAR MINI RECHRG W/RC TURBO 40MHZ RX-7	$14.95	$9.95	$5.00
GT-3030	CAR MINI RECHRG W/RC TURBO 40MHZ SKYLINE	$29.95	$9.95	$20.00
GT-3036	CAR MINI RECHRGE W/RC SOUND 27MHZ SUPRA	$29.95	$9.95	$20.00
XC-0160	CLOCK ALARM BOOMBOX 8BEATS RETRO SLV	$29.95	$10.95	$19.00
XC-0159	CLOCK ALARM DIG BASKETBALL 105MM	$14.95	$7.75	$7.20
AR-1732	CLOCK LCD BACKLIT W/IR REMOTE CTRL LEARN	$29.95	$12.95	$17.00
XC-0170	CLOCK PIN MECHANICAL SLV W/PSU	$99.00	$69.95	$29.05
GH-1525	CLOCK PLASMA BLU W/DESK MNT & PSU	$59.95	$39.95	$20.00
GH-1152	COCKTAIL SHAKER W/ACCESSORIES	$14.95	$6.95	$8.00
GH-1377	COOLER/WARMER 4L 12VDC SLV	$44.95	$31.95	$13.00
TH-2139	GARDEN TOOL SET 3PCE W/POUCH	$19.95	$14.95	$5.00
GH-1018	GOLF BALL PICK-UP TOOL	$9.95	$4.95	$5.00
XL-2512	LAMINATING SLEEVES A4 PK25	$13.95	$6.95	$7.00
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Vintage Radio

By RODNEY CHAMPNESS, VK3UG

The Harbros 12/54B transceiver

Designed specifically for rural fire brigade networks in the early 1950s, the Harbros 12/54B transceiver was a 12-valve unit with some interesting design features. It superseded army-surplus transceivers that had been adapted for the job and was much easier to operate.

By the end of World War 2, the value of radio communications was apparent and returned servicemen from country areas quickly realised that 2-way radio could help coordinate fire-fighting activities. Not only would it make such activities more effective but it would ensure greater safety for firefighters as well.

At that time, here were many thousands of high-frequency (HF) portable transceivers available on the military surplus market at very moderate prices. As a result, transceivers such as the FS6 and the 122 (described in May 2003 and October 2003 respectively) were quickly pressed into service on rural fire-brigade services. In addition, many of these sets were used by the Flying Doctor Service and by fishing fleets.

The 122 required no modifications to make it suitable for use in these services, as it had both a variable-frequency oscillator (VFO) and a crystal-controlled transmitter. However, the FS6 and many other ex-service sets did require changes, as their transmitting frequencies were controlled only by a VFO. The Postmaster Generals Department required the transmitters to be crystal-controlled, which meant they had to be modified and submitted for approval.

The view shows the author's fully restored unit. The cabinet was repainted a hammer-tone green colour, which closely matches the original finish.

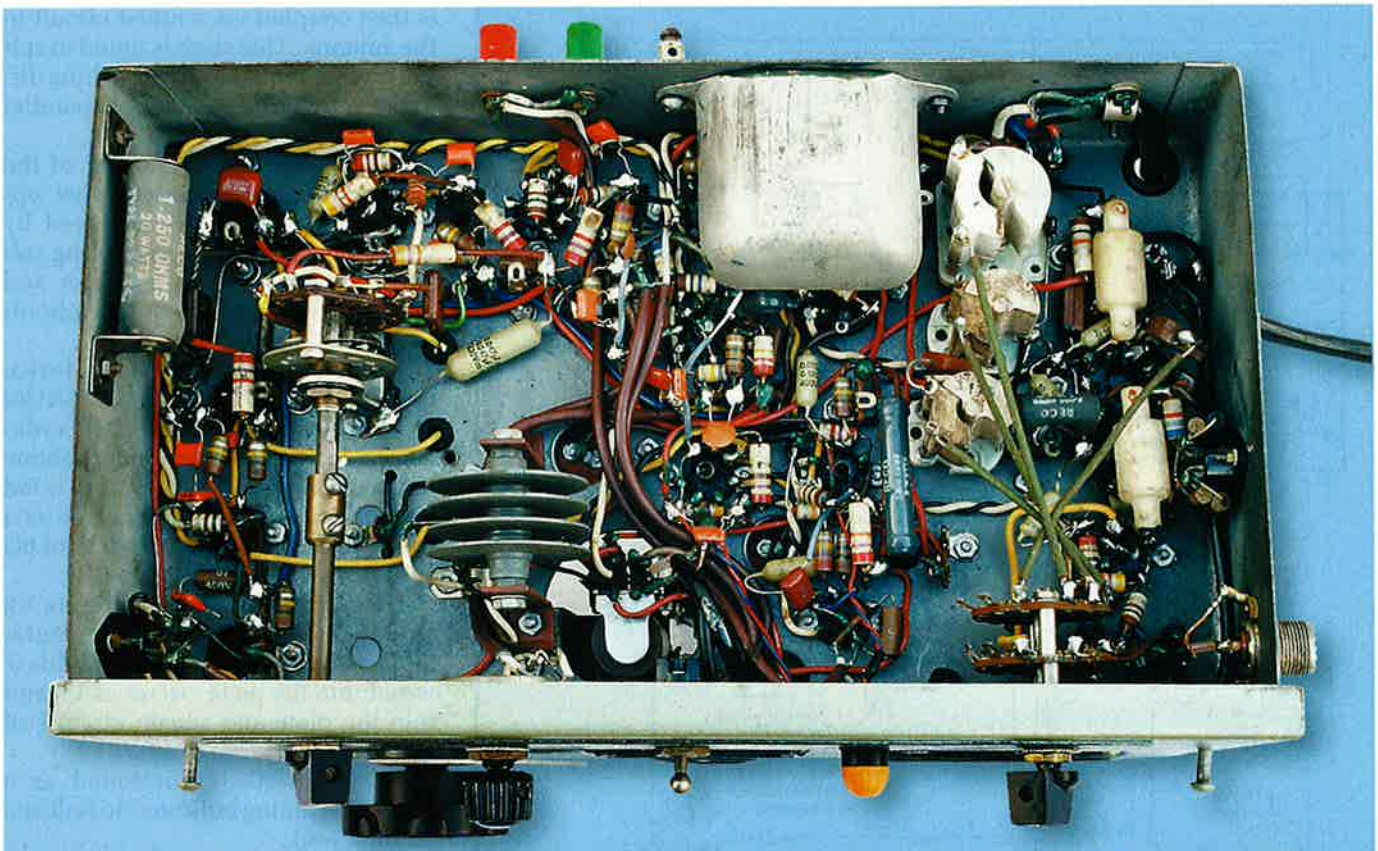
Disadvantages

Although army-surplus transceivers worked well in these roles, they did have their disadvantages. Generally, they were quite bulky and heavy, were often difficult to service and could often only be operated effectively by someone with technical knowledge. They also usually had limited power outputs while at the same time drawing high currents when operated from a vehicle battery.

That list of negatives didn't prevent the sets from being used for fire-brigade or fishing fleet communications though. When you have nothing else to use, you will work around any problems you encounter – which the various operators and networks did with considerable success. More suitable commercial transceivers were rare and costly at that time.

As the supply of cheap army-surplus equipment gradually dried up, manufacturers began releasing commercial HF transceivers to meet the increasing demand for equipment. Naturally, this new equipment was manufactured to meet specific requirements, rather than being adaptations of military equipment.

For example, some manufacturers concentrated on producing marine equipment, while others concentrated on land-based applications. One such company, Hardinge Brothers of Horsham, Victoria, specialised in HF transceivers for the rural fire-brigade networks



An under-chassis view of the Harbros 12/54B transceiver. The receiver circuitry is to the left, while the transmitter circuit is to the right.

– mainly the Country Fire Authority networks in Victoria.

The Harbros 12/54B

Hardinge Brothers produced domestic radios before the war, although apparently only in limited quantities. The company subsequently tooled up for the production of HF transceivers in the early 1950s and the first unit produced (as far as I am aware) was the 11/53M – an 11-valve, single channel, HF transceiver with an output power of 5W. The "11" in the model number refers to the number of valves used, "53" to the year of initial production and the "M" to the fact that it was primarily a mobile transceiver.

The later 12/54B model is a 12-valve unit (not including power supply rectifiers), first manufactured in 1954. It was primarily intended as a base transceiver and is rather more versatile than the 11/53M, as it could transmit on three crystal-locked channels. The receiver could tune continuously from 2-6MHz and also boasted two crystal-locked channels.

The controls on this set are somewhat simpler to understand and use compared to the ex-service equipment, as the more critical transmitter tuning controls are preset within the case. In fact, there are only five controls in all: (1) receiver audio level; (2) receiver tuning (2-6MHz); (3) transmitter frequency selector; (4) receiver variable tune or crystal-locked tuning selection; and (5) noise limiter on/off. The power on/off switch has three positions: (1) 12 VDC; (2) off; and (3) 240 VAC mains.

The 12/54B transceiver was expected to operate on AC power most of the time, with 12V DC operation included as a back-up in case the base station location lost mains power.

Receiver circuit

The receiver circuit (see Fig.1) is similar to that used in many high-performance domestic receivers of the era. A 6BA6 (V1) acts as a tuned RF stage and this is followed by a 6AE8 (V2) as a frequency converter. Although a conventional oscillator circuit is used for the variable tuning, two frequency-controlling quartz crystals in a Pierce oscillator circuit are used for fixed-frequency reception.

Next comes a 455kHz IF amplifier based on a 6BA6 (V3) and this is then followed by a 6N8 (V4) as the second detector, AGC diode and first audio amplifier. The audio from the detector then goes to a noise limiter which uses a 6AL5 (V6) dual diode. This stage limits impulse interference, after which the audio is fed to the 6N8 pentode section.

A 6AQ5 (V5) functions as the second audio amplifier which in turn drives the loudspeaker.

Transmitter circuit

The transmitter section uses six valves in all (V7-V12). A Pierce crystal oscillator based on a 6AQ5 (V11) and three switch-selectable crystals sets the carrier frequency, although only two crystals were usually fitted to the unit. For example, in the unit I have, the crystal frequencies are 2692kHz and 4510kHz. The third position was left vacant, as licences were usually only issued for two frequencies.

The output of the crystal oscillator is applied to the grid of the RF (radio frequency) power amplifier, which is based on a 6L6G (V10). V10's output

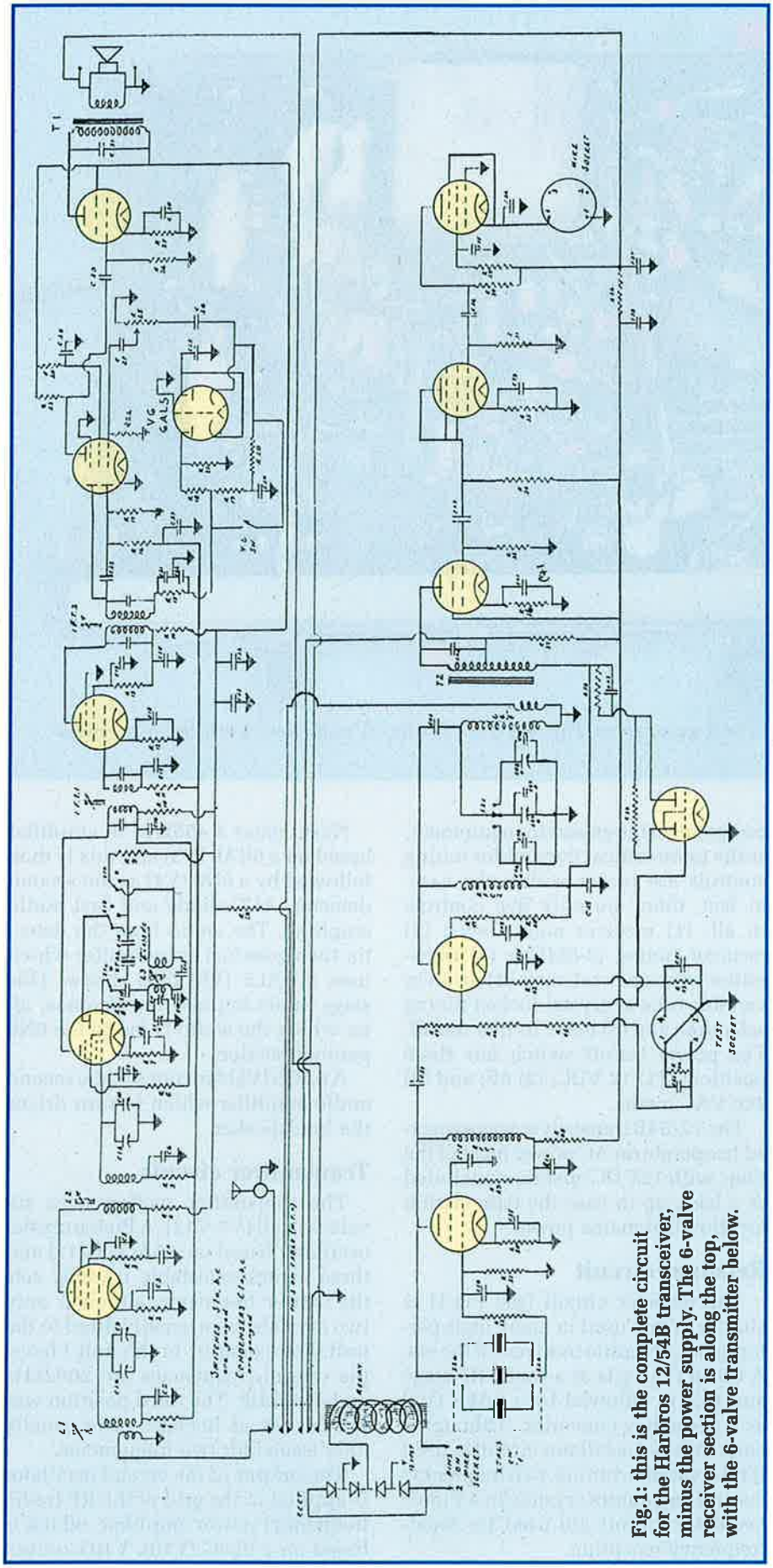


Fig.1: this is the complete circuit for the Harbros 12/54B transceiver, minus the power supply. The 6-valve receiver section is along the top, with the 6-valve transmitter below.

is then coupled via a tuned circuit to the antenna. This stage is tuned to suit the crystal frequency by switching different values of capacitance in parallel with the output coil.

In operation, the "loading" of the transmitter is adjusted to give optimum output. This is achieved by varying the position of a coupling coil which is wound onto a former and placed over the main tuned circuit winding – see photo.

The modulator is a 3-stage device based on valves V7-V9. V7 (a 6AU6) is wired as a grounded-grid audio amplifier, with a carbon microphone in the cathode circuit. Its output is fed to another 6AU6 (V8) connected as a triode and this in turn feeds a 6L6G (V9) modulator output valve.

The resulting audio signal from V9 modulates the RF signal via a centre-tapped audio choke. As shown, this is wired into the plate circuit of V9 and into the plate and screen circuits of the RF output stage (V10).

V12 (6U5/6G5) functioned as a magic-eye tuning indicator (to indicate modulation).

PTT switch

The changeover from receive to send is accomplished by pressing the PTT (press-to-talk) button on the unit's Zephyr carbon microphone. This actuates a 3-pole relay and one set of contacts transfers the HT (high-tension) voltage from the receiver to the transmitter. At the same time, a second set of contacts swaps the antenna from the receiver to the transmitter, while the third set removes a short circuit from the HT at V7 in the modulator and shorts the loudspeaker voice-coil to earth.

The last operation is necessary to prevent acoustic howl from occurring at the changeover from transmit to receive and vice-versa. It occurs because the transmitter and the receiver remain in operation for a fraction of a second after a changeover, as the filter capacitors in the supply rails take a finite time to discharge after the HT is removed.

Mechanical clean-up

The transceiver featured here had been in continuous service from 1961 until the early 1970s, when the Country Fire Authority changed to VHF radio communications. It then ended up in a garage at a coastal location, where

the salt-laden air rusted the cabinets. When I used an angle-grinder to clean the rust off the lid, I found that it had penetrated some distance underneath the paint.

Fortunately, the transceiver and power supply cabinets were in much better condition. After removing the circuitry, they were rubbed down with fine sandpaper to remove any loose paint and rust. The cabinets were then cleaned down with turpentine and given a coat of Wattyl Killrust metal primer undercoat.

That done, I went looking for a spray paint that would roughly match the original green. Eventually, I came across a hammer-tone metal finish in Jade Green. This closely matches the original hammer-tone finish so I bought a can, even though it is rather expensive. It is labelled as Galmet metal protection and is easy to use.

Next, the knobs were removed and cleaned by scrubbing them with a nail brush dipped in soapy water. They were then polished with an automotive cut and polish compound and now look much brighter.

Next stop was the volume control. This was extremely stiff to rotate, so I sprayed Inox cleaner onto the shaft and rotated it back and forth until it operated freely. The valves were then cleaned with soapy water, with only gentle rubbing on the glass envelopes to ensure the labelling remained in place.

As a precaution, the octal valves were all held upside down while this work was being done, so that no water could seep into the valve bases. This isn't necessary with the miniature valves, since the valve pins emerge directly through the glass envelope.

After that, it was a matter of attending to a few sundry details. The front panel was cleaned with a kerosene-soaked rag, after which the dents were removed from the speaker grill. The grill was then resprayed with flat-black paint and came up looking like new.

A kerosene-soaked rag was also used to clean the top of the transceiver chassis. I also replaced the 240V power lead (it was starting to perish), cleaned the microphone and adjusted the PTT switch.

Servicing the power supply

A combined 240VAC and 12V vibrator power supply is used in these units. and this one wasn't without its problems. A quick inspection revealed that the 2nF buffer capacitor in the vibrator section had been overheating and had leaked wax onto the bottom cover of the power supply.

The major components are neatly laid out on the top of the chassis. Power comes from an external mains/vibrator supply.

I initially checked the capacitor with my 1000V tester and found it had a leakage resistance of about 30MΩ. I then decided to heat the capacitor with a hair drier and observe the change (if any) in its leakage resistance. When I did this, its resistance quickly dropped to just 1.5MΩ, so it was replaced immediately.

Unfortunately, I didn't have a suitable high-voltage (2000V) 2nF capacitor so I made one up using three 8.2nF 630V polyester capacitors in series across the secondary of the transformer. The higher resulting value (about 2.7nF) gives a lower standing current with no load, so the transformer is better tuned than it was with the original 2nF capacitor. The voltage rating of the three capacitors in series (about 1890V) is slightly lower than the rating of the original capacitor but this is unlikely to cause problems.

The circuit shows the vibrator to be a V6612 Oak unit. However, a V6606 is fitted with a 20Ω resistor in series with the reed drive to drop the voltage to around 6V. The drive voltage was 9V, so I changed the resistor to 56Ω and the voltage is now much nearer to what it should be.

The vibrator itself is not mounted in a resilient-mount socket, so the noise is quite noticeable when the unit is operating. It probably really doesn't matter, as this is a communications transceiver and the receiver is likely to be used in an area where interference and general background noise is present anyway.

The supply was also checked for any shorts or low-resistance readings from the high-tension (HT) line to chassis. There were no problems here, so the two 6X5GT rectifiers that had previously been removed were reinstalled. The supply was then switched on and the voltage across the filter capacitors carefully monitored. Then, after a few seconds, the supply was turned back off again, this cycle then being repeated several times to reform the electrolytic capacitors.

It really pays to be rather gentle with 6X5GT rectifiers, as they are prone to develop short circuits from cathode to filament if they are abused to any extent. When I had finished overhauling the transceiver, I took the same precautions with it, as it is on a separate chassis to the power supply.

Overhauling the receiver

As is my usual procedure, I commenced overhauling the receiver section by testing the paper capacitors. And I have to say that the units fitted to this set would have to be the worst batch I have come across.

Photo Gallery: Kingsley Kit Set KFT-1

First marketed in Australia in 1946, this Kingsley receiver used "ferrotuning" to tune in stations (as opposed to the more conventional variable-capacitance tuning). This new system used a grooved brass spindle to actuate sliding iron-dust cores inside the tuning coils, thus varying their inductance. The set came with a colourful dial and circuits for three, four and 5-valve models were available. The unit shown here is a 5-valve KFT-1 medium-wave model using 6J8G, 6U7G, 6G8G, 6V6G and 5Y3G valves. Ferrotuning never gained widespread popularity and such sets are now a rarity. (Restored by Maxwell Johnson; photo by Ross Johnson).

They consisted mostly of miniature AEE units (brown coloured) and their leakage resistances varied between 1-10MΩ (as measured on a high-voltage tester set to the 500V range). A couple of these capacitors were also buried under shielded audio cables and unless you went looking for them, they could have been easily missed.

I had no option but to replace the lot, the only exceptions being the cathode bypasses on several of the valves. In the end, some 26 capacitors in total were replaced in the receiver and transmitter circuits.

The resistors were mostly 20% tolerance types and most had gone high by about 20%, so I didn't need to replace any. I also checked the speaker transformer to make sure there was continuity across the primary winding and this proved to be intact.

This close-up view shows the power amplifier tank coil, together with the coupling coil which has too many turns. The roughly-wound 3-turn coil over the tuned winding gives better performance.

Once these checks had been completed, it was time to apply power. I began by reforming the electrolytic capacitors as described previously, then let the receiver run. There wasn't so much as a peep out of it – it was dead quiet.

It was time for some troubleshooting and I started by checking the voltages around the 6AQ5 output stage (V5). This showed that the cathode voltage was zero, which meant that no current was being drawn by the valve.

I also measured the heater voltage and found that there was 12V across the valve socket instead of 6V. This indicated that the heater had probably gone open circuit.

I removed the valve and found that the heater was intact, so I replaced it again. It still wasn't drawing current, so I removed it again, re-tensioned the socket pins and gave the socket a spray with Inox lubricant. This time there was some action and the receiver came to life, although it was very noisy.

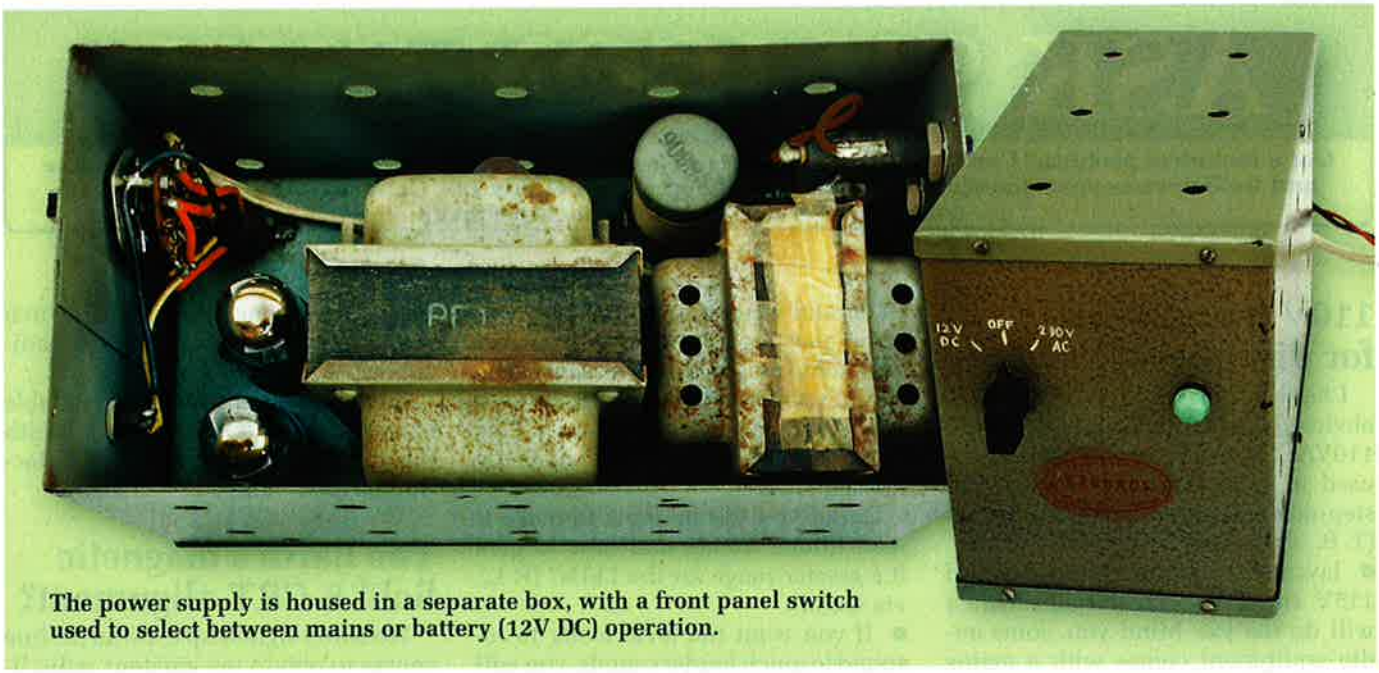
I tried wriggling the valve around in its socket and this produced loud crackles. After moving the valve around for a while (to clean the contacts), these crackles disappeared – or at least, they did for this stage. There were still problems elsewhere.

Next, I tried moving the 6BA6 RF stage (V1) around in its socket and the same crackling problem occurred. Its socket was also then sprayed with cleaner and the pins re-tensioned before replacing the valve. And again, the crackling problem disappeared.

The set was now sounding much better, so I attached a signal generator to the receiver's antenna, tuned to one of the crystal-locked channels and adjusted the generator for an audible signal. The sensitivity was poor, so I checked around the 6AE8 converter stage (V2) and cleaned the frequency selector switch which was also noisy.

This made no difference to the sensitivity so the 6AE8 was removed and its socket also given the "treatment". This did improve the performance but when I subsequently touched the 6BA6 IF valve (V3), the crackling became quite bad and the sensitivity varied widely.

This valve was also removed and its socket cleaned and tensioned, after which the sensitivity improved quite



The power supply is housed in a separate box, with a front panel switch used to select between mains or battery (12V DC) operation.

noticeably. I then checked the remaining valves and found that their sockets all had bad contacts.

These were all given a good clean up and the receiver was now turning in a reasonable performance. All those years spent in a salt-laden atmosphere had certainly caused some problems.

Receiver alignment

At this stage, I decided that a quick realignment of the receiver's front-end was the way to go.

First, I set the tuning to the 2692kHz crystal-locked position and rotated the receiver's tuning dial until an increase in sensitivity was observed. That done, the signal generator was adjusted until the signal was audible. I then peaked the RF and aerial coils slugs for best performance, after which the receiver was switched to 4510kHz and the signal generator and receiver tuning again adjusted for best performance. The aerial and RF coil trimmers were then adjusted.

Unfortunately, the variable frequency oscillator adjustments did not line up with the settings for best reception on crystal-controlled operation. As a result, I set the receiver up for best performance on the 2692kHz crystal-locked position with the signal generator, then switched to the tunable position and adjusted the oscillator slug until the 2692kHz signal was heard. I then did the same on 4510kHz, this time adjusting the oscillator trimmer.

The set now tunes quite well and signals well below a microvolt are readily heard. It really is quite a "hot" receiver!

I didn't touch the IF alignment, as it appears to be perfectly OK. Note that care is needed in tuning the IF of a crystal-locked receiver, as just peaking the IF alignment may mean that the receiver is no longer tuning the frequency it is intended to tune.

For example, to tune to 2692kHz, the receiver's crystal oscillator must operate at 3147kHz. That's assuming an IF of 455kHz (ie, 3147 - 2692 = 455). However, if the IF was aligned to say 465kHz, the actual frequency that the receiver would now tune would be 2682kHz (ie, 3147 - 465 = 2682).

At this stage, there was just one remaining problem with the receiver – the hum level was quite noticeable. It became inaudible when the volume control was reduced to zero and I subsequently found that better shielding around the detector and noise limiter (6AL5) improved the situation.

When the set is on vibrator supply, there is noticeable vibrator hash and the use of the noise limiter is desirable. It's not the best noise limiter in the world but it does work.

Overhauling the transmitter

Like the receiver, the transmitter had many leaky AEE capacitors that had to be replaced. And like the receiver, the resistors were all OK but just within tolerance.

Having replaced the capacitors, it was time to test the transmitter into a dummy load/power meter. I pressed the button on the microphone and adjusted the tuning capacitor on each of the transmit frequencies but could only get 5W output on 2692kHz and 3W on 4510kHz with 15W input – pathetic!

My suspicion was that the link coupling coil to the antenna had too many turns on it (12). To test this, I temporarily converted the output circuit to a Pi coupler and the output increased to 7W on 2692kHz to 8W on 4510kHz. I then experimented with the link coupling coil and found that three turns (instead of 12) resulted in an output of 6W.

This was still rather pathetic, as with 15W input to the V10 plate circuit, the output should have been around 10W. The rated input to the transmitter is 20W but I wasn't pushing it that hard with my temporary link coupling system.

The transmitter output stage doesn't gain any accolades from me. The ratio of the inductance and capacitance in the tank circuit (PA output tuned circuit) is not correct across most of the band to which it tunes. Furthermore, the link coupling method used for extracting the RF energy from of the tank circuit doesn't work efficiently in these transmitters. In my opinion, a better-designed output circuit would achieve an efficiency of 60-65% in the PA circuit. **SC**

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110V transformer for disc player

I have a mini-disc player which is obviously made for USA and runs on 110VAC. Is there any way this can be used in Australia with some sort of step-down device or voltage selector? (T. B., via email).

● Jaycar Electronics have a range of 115V stepdown transformers which will do the job. Mind you, some audio equipment comes with a mains transformer with two 120V primary windings connected in parallel for 115V operation. If you are competent in this area, you could reconnect the primary windings in series for 240V operation.

If you are lucky, you may even find that the internal wiring can be easily changed or there may even be an internal switch.

Level meter for cocktail bar

I have just completed building the Loudspeaker Level Meter for Home Theatre Systems from the April 2004 issue and I hope you could answer some questions. I own a cocktail bar with some noise issues. I need a means to show the bands and DJs how loud they are and a level not to go over. This meter seems ideal, apart from being too sensitive.

Could you tell me how to make it read louder noises and how to give it a greater range for the LEDs? (P. L., via email).

● If you want the level meter to respond to much louder sounds, you will need to reduce the sensitivity of the first op amp stage. The easiest way to do this is to increase the 100Ω resistor to 1kΩ or even 2.2kΩ. However, it will still only read over a 20dB range.

If you need to monitor sound levels over much wider ranges, the only practical way to is use a sound level meter. These have more than 100dB of measurement range. In fact, you may have a legal requirement (ie, WorkCover) to avoid exceeding certain sound levels and you may need a sound level meter to show that you are able to monitor and meet this requirement.

The sound level meter could perhaps be used to set the sensitivity of the Loudspeaker Level Meter which could then give an easy visual indication.

Sound level meters are available from Altronics (Q-1264), Dick Smith Electronics (Q-1362) and Jaycar Electronics (QM-1588).

The Earth's magnetic field & CRT alignment?

I recently signed up to do an on-line course to obtain my amateur radio license. As part of this course, there is an on-line forum that you are encouraged to join where questions and answers may be posted (a newsgroup).

Shortly after signing on, I read a message from a chap who had moved from England to Sydney and brought his large, wide-screen Sony Trinitron colour TV with him. This TV set now has a colour registration problem. The colours are all distorted (like you held up an unshielded hifi speaker to the side of the set). The fault is down both the left and righthand sides of the tube and it looks like it badly needs degaussing. However the set's internal degauss circuit does not seem to be able to correct the problem.

So I sent a post to this chap suggesting that I thought his problem may be related to the Earth's magnetic field. In point form my post basically said:

(1) That being in the IT industry I was aware that computer monitors are aligned/manufactured for either the southern or northern hemispheres.

(2) I had seen first-hand an entire shipment of northern hemisphere colour monitors shipped to Australia by mistake and that they all looked like they badly needed degaussing.

(3) That while I had no first-hand knowledge of TVs, that I assumed that this problem would be inherent to both monitors and TV sets as both fundamentally use a CRT.

(4) That I suspected that his fault may be a result of his TV being aligned by the manufacturer to the northern hemisphere's magnetic field charac-

High-Energy Ignition For A Honda Prelude

I have purchased a Universal High Energy Ignition project, as featured in the June 1998 issue of SILICON CHIP. I have had it for a while and had planned to install it in my old car. However, I sold my old car and have recently had the ignition module in my new car fail. It is a Honda Prelude and from what I have found out, the signal from the ECU is a 5V square wave. Is there a way to adapt the High Energy ignition for my application? (D. W., via email).

● The High Energy Ignition can be operated from a 5V signal if you use the Hall Effect circuit without including the 820Ω pullup resistor. The 5V is connected to the Hall Signal input on the PC board. Ignore the Hall + and Hall GND connections.

The voltage sense from the ECU may be inverted so that the spark occurs on a 5V to 0V transition, using a transistor. To do this, remove the 10kΩ resistor connecting to transistor Q2's base and connect a wire from the tachometer output at the collector of transistor Q3 to the base of Q2.

Note that the collector of Q3 and the base of Q2 connect to adjacent tracks on the PC board, so just bridge these two tracks with a short length of tinned copper wire.

teristics and that the fix may actually involve realignment of the CRT. I suggested that this was something that should not be attempted by the inexperienced, as the end result would most certainly be worse than the current problem.

(5) That I thought the problem was probably related to the reason why magnetic navigation compasses (mostly the flat orienteering types) also were manufactured differently for the northern and southern hemispheres; ie, the pointer needle requires different counter balancing so that it rests horizontal to the Earth's surface and does not try to either point skyward or down into the Earth.

Within a short period of time, no less than two full-call amateurs had posted rebuttals to the Forum. One was from one of the on-line facilitators for the course I was now enrolled in who has a degree in electronics and electrical engineering. He summarised my entire post as "Horse Excreta" and categorically stated that "no such manufacturing process exists" in reference to my assertion that computer monitors were made for either the northern or southern hemispheres.

He was so emphatic and obviously knew more about the Earth's magnetic field than I will ever know, that I am now beginning to think that maybe I'm a fool who has been taken in by a popular urban myth. So what is the truth to all this?

Are TV sets susceptible to the Earth's magnetic field at all, in that the alignment of the CRT must counter this field? Is the magnetic field in the northern hemisphere somehow different in nature to that in the southern hemisphere, thus requiring different CRT alignments?

And even if this is all true, was it reasonable to propose that the colour registration problem in question might be related to this effect? (S. A., via email).

● You are absolutely correct and your protagonists are utterly wrong. Large CRTs for TV and computer monitor use are set up for northern or southern hemisphere use. Generally, this is via a few small fixed magnets on the yoke assembly. To change the setup of a northern hemisphere set for the southern hemisphere probably requires the services of your local Sony agent. However, the tube will also have to be manually degaussed.

An excerpt from **http://repairfaq.ece.drexel.edu/sam/crtfaq.htm#crtnsh** (apparently from a Philips engineer) adds further to the above:

"There are two types of adjustments:
(1). The passive ones that are done in the picture tube factory; and
(2). The active ones that are done by the set maker and/or the customer.

In the factory, inside the neck of every (Philips) tube, a metal ring is permanently magnetised to create a multi-pole correction field. Then each tube is matched with a deflection yoke to achieve optimum colour purity. It is possible that a couple of yokes must be tried in succession.

This matching is done under specific ambient magnetic field conditions. On oriental tubes, you will often see little permanent magnets added to achieve further fine correction of landing and/or convergence. When the tube is within landing specification, it is shipped to the set maker.

Ultra-LD Clipping Indicator Has Drawbacks

Referring to your Ultra-LD Preamp & LED Display in the November 2001 issue of SILICON CHIP, there is a question that comes to mind. This unit is checking the clipping points of IC1 and preceding equipment rather than that of the power amplifier.

According to information I've found on a website, Rod Elliott of ESP (**http://sound.westhost.com/project23.htm**) states that "most clipping indicators published over the years rely solely on an attenuated version of the output signal, supplied to a suitable comparator circuit. That would be fine if the mains voltage stayed exactly the same at all times and if the power supply had perfect regulation. The fact is neither of these is true and the amplifier's DC supply voltage can vary considerably from hour to hour and even minute by minute".

The clipping detector shown on the above website relies on one factor (and again I quote): "how close to the supply voltage is the power amplifier's output signal at any instant in time. If and when the supply voltage varies, the detector varies along with it and will detect even a very short peak that crosses the detection threshold". This unit is connected across the power amplifier's speaker terminals.

I would appreciate it if you would enlighten me on this matter with regard to your circuit. (G. K., Elizabeth, SA).

● It is true that most clipping indicators have a drawback because the amplifier's supply rails are not regulated. The same drawback applies to the clipping indicator in the Ultra-LD circuit – it is not a precision circuit and it only gives an approximate indication that clipping is probably occurring if the topmost LED is alight.

Some clipping circuits (eg, page 72, November 2003 issue and the one on Rod Elliott's website) assume that if the signal rises to within 5V or so of the positive or negative amplifier supply rail, the output transistors must be saturated and therefore clipping is occurring. However, it is still only an approximation. In fact, Rod Elliott's circuit assumes that if the signal comes within 3V of the supply rails, clipping is occurring.

In most amplifiers with Mosfet or emitter follower output stages (virtually all modern amplifiers), that would be fairly severe clipping since the output transistors are typically saturated with a collector-emitter voltage of 6V or more. This is usually a limitation in the driver stages rather than in the emitter follower output stage. We tried to eliminate some of this drawback by running high-voltage rails to the driver stages of the Ultra-LD amplifier.

If you really want to produce an exact clipping circuit, you need to precisely compare the input and output signals of the amplifier, so that even a small degree of clipping can be detected. In practice though, small degrees of clipping are very difficult to hear on music signals and so most clipping indicator circuits are quite adequate in this respect.

Cooked SC480 Amplifier Modules

I have constructed two SC480 amplifier modules with TO-3 output transistors (SILICON CHIP, January & February 2003). One has burnt out the resistor between the base of Q9 and trimpot VR1. The resistor at the emitter side of Q6 has also gone.

The other amplifier module is getting 80+ volts across the 6.8Ω resistor and will not allow the quiescent current to be adjusted. Transistors Q4, Q5 and Q6 are getting very hot. I have only been doing electronics for four months and would appreciate all the help you can give me. (R. J., via email).

● You need to check both your amplifier boards very carefully to see that you have correctly installed all the transistors and diodes.

In the case of your first amplifier module, it seems possible that you may have inadvertently swapped Q8 & Q9 – this may have damaged both these and other transistors. You won't know until you reassemble the module and re-check the voltages with the 560Ω current-limiting resistors.

On the second board, with Q4, Q5 & Q6 overheating, it seems likely that you have inserted diode D3 the wrong way around. Again, the transistors may have been damaged.

Notes & Errata

Automatic Alternate Motor Switch (Circuit Notebook), September 2005: the pole of switch S1a should connect to +12V via the contacts of the time clock, not to +5V as shown.

Filter For Ripple Control Mains Tones, Circuit Notebook, September 2005: WARNING: Do not use this circuit. Due to a major oversight, this circuit was not tested at 240VAC which would have highlighted the following drawback. Regardless of the values of the capacitors selected for the circuit, their reactance will be quite low, resulting in the application of high voltage to the 2W potentiometer which will fail at switch-on.

Depending on the sophistication of the circuitry in the (television or monitor) set, the set maker can adjust geometry and sometimes convergence (if there is a set of convergence coils present). If there is a rotation coil present, then this may also improve the landing a bit.

In "digital monitors", there are flexible waveform generators to adjust the corrections. There may be further adjustments possible for the uniformity of the colour point and brightness. This gives a place-dependent modulation of the three beam currents; it does nothing to improve the landing.

The most expensive monitors (large screen, fine phosphor pitch, very critical on landing) may have active magnetic field compensation in all three directions, with electronic magnetic field sensors for automatic adjustment.

These monitors should be mostly insensitive to the Earth's magnetic field. (This technology was originally invented for the use of CRT displays onboard jet fighter planes, which tend to turn relative to the earth).

All other monitors will degrade picture quality when the degaussing is not able to completely compensate for the Earth's magnetic field. With a tube built for the wrong hemisphere, it is possible that the effect of the vertical component of the Earth's magnetic field will give a residual landing error. This cannot be corrected by turning any of the available adjustments, digital or not. Re-alignment might become a very costly job."

Nail finder for woodworkers

In Ask SILICON CHIP for August, you replied to an inquiry about making a metal detector for use in woodworking, saying that some detectors meant for studs (and metal) could do the job.

I agree and have several such detectors but the they require a lot of tedious close scanning. Could you point him to Carba-Tec NSW Pty Ltd, 113 Station Road, Auburn, NSW 2144. Phone 1800 683 583 and ask for Cat. MMD2 and get a dedicated detector for $49.00. That's only $19 more than the $30 for the stud one. He could not build it for that!

No, I do not belong to the firm but I have bought a lot of stuff from them and they are very good. (J. W., via email). SC

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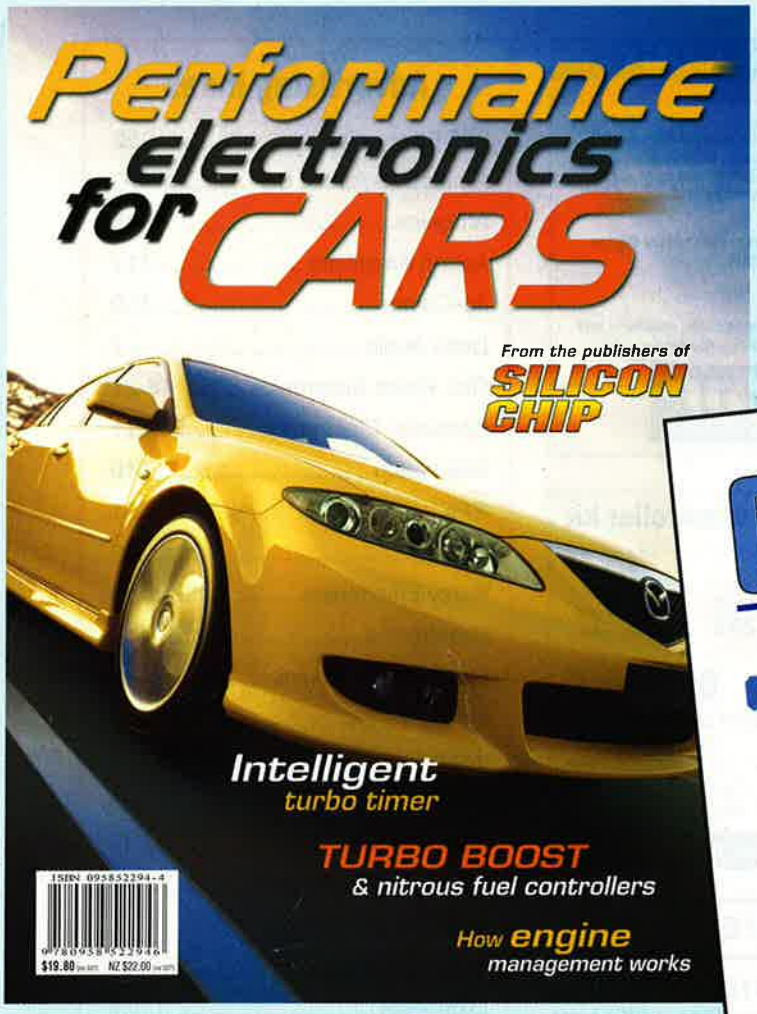
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Switch devices on and off using the sensors already under the bonnet – lots of uses from water-spray and fan control to nitrous oxide switching

77 **CHAPTER 13: Temperature Switch**
A cheap general-purpose adjustable design that can work all the way up to 245°C

We'll let the contents speak for themselves:

- Not a reprint – new projects and articles not published before
- Learn how engine management works
- Build projects to control nitrous, fuel injection and turbo boost systems
- Switch devices on and off on the basis of signal frequency, temperature and voltage
- Build test instruments to check fuel injector duty cycle, fuel mixture and brake and coolant temperatures
- PLUS LOTS MORE

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Swapped out the transmission or altered the diff ratio? – this project will get your electronic speedo reading accurately again

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This turbo timer set the engine idle-down time to match how hard you've been driving

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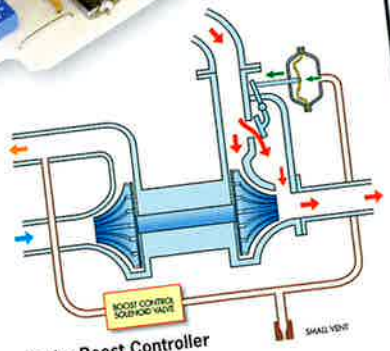

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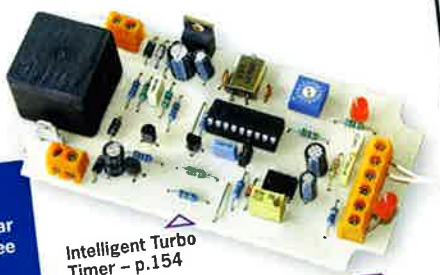

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Where To Buy The Kits

Kits for every project described in this book are available from Jaycar Electronics stores and dealers all over Australia and New Zealand. See the inside front and outside back covers for further details.

Order direct from Silicon Chip Publications

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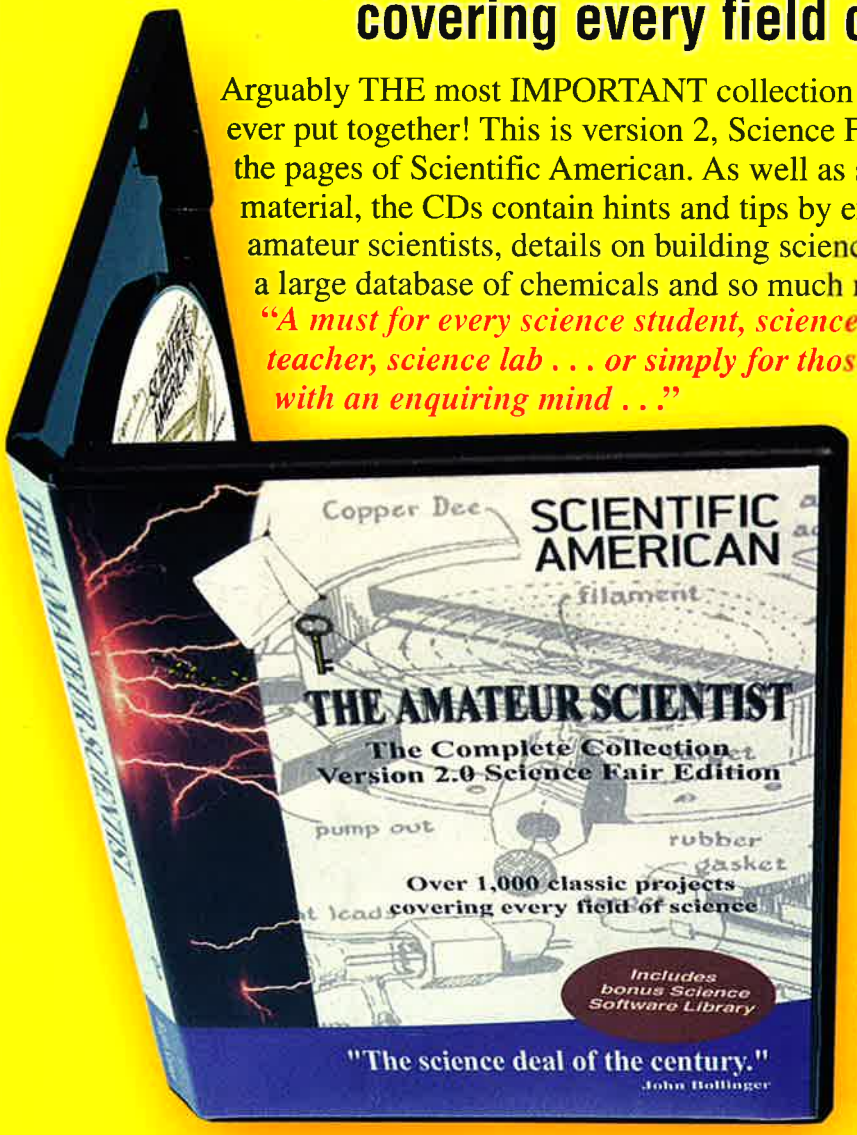
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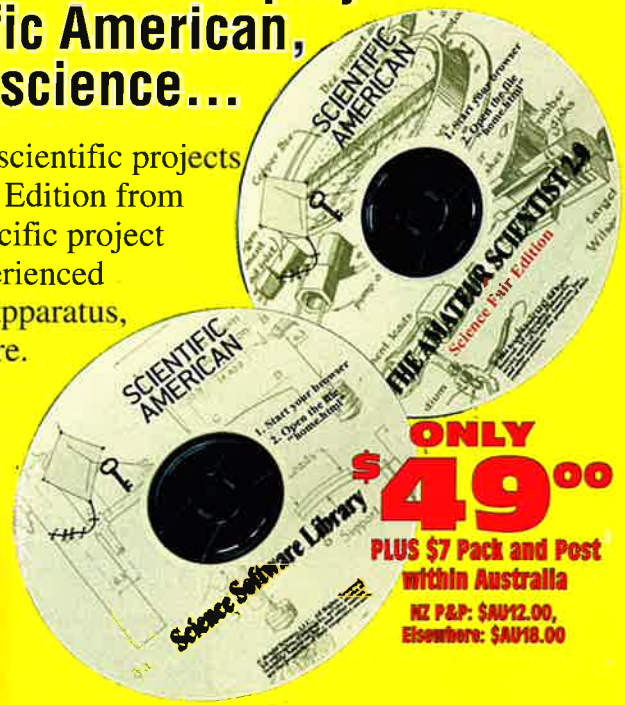

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